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PARALLELING OF ALTERNATORS.

MR. HAMMOND'S paper on this subject, read before the Northern Society of Electrical Engineers, does not treat the matter from a technical point of view; it is, therefore, not of great interest to electrical engineers.

The historical introductory remarks are evidently intended to prove that the West Brompton station was the pioneer in parallel running of alternators, but in the face of Wilde's, Hopkinson's, and Adams's well-known experiments and results on parallel running of alternators, showing clearly that parallel running was not only possible, but perfectly practicable, years before the West Brompton station existed, we must confess that we fail to see where West Brompton comes in as a pioneer.

Despite Mr. Hammond's reference to his early work at Eastbourne, following Mr. Ferranti's lead in paralleling transformers, we think it is only fair to point out that the paralleling of transformers was first suggested in the "Correspondence Columns" of the ELECTRICAL REVIEW in 1882, and was first put into practice by Zipernowski in 1885. If it is of any importance to the electrical engineers to whom this paper is addressed to know who were the pioneers of the "alternating high tension system," it is surely the duty of the author to give the whole history, and not merely the modern part of it.

Mr. Hammond, by means of his 28 questions and the answers given in his paper, shows a few interesting points in regard to alternating current working, but it is exceedingly difficult to draw deductions of any value from them.

Whether machines are, or are not, to run in parallel at a supply station does not depend on the question whether they can be paralleled or whether they cannot. At this date there is no dispute as to paralleling alternators; the subject is perfectly well understood and presents no difficulties, and in every case paralleling is provided for, whether used or not.

The answers to the question regarding efficiencies seem valueless, for which efficiency is meant is not stated. Some give a "commercial" efficiency of 93 per cent., an obviously absurd statement, unless commercial efficiency is carefully defined. On this point we agree with the author, and would have all efficiencies given as $\frac{\text{E.H.P.}}{\text{I.H.P.}}$

Question 16 is, in the year 1896, somewhat out of date, and the answers prove that it is not important to bring machines into phase before paralleling. It is well known that if the machine to be thrown in is run at a speed slightly above synchronism, and then switched on, it will fall easily into phase; the elaborate arrangements for showing the instant of co-phased synchronous running seen on the average switchboard are perhaps ornamental but are not of much practical use.

The author favours low periodicity, and suggests the introduction of a standard periodicity. These are points we have often insisted upon.

This paper being principally a collection of answers to questions, and expressions of opinion given by station engineers, indicates the nature of the experience gained by some of them in working alternating current systems, and on the whole it would seem that this system is working very satisfactorily.

THE X RAYS AND THE NEW PHOTOGRAPHY.

Prof. Röntgen's startling discovery seems at present to be occupying more or less the attention of the whole scientific world. Most of this attention has consisted in mere repetitions of experiments made by Röntgen and others, but undoubtedly many improvements in the apparatus and methods of obtaining the new photographs have been effected since the first publication of the discovery.

In America, Dr. Pupin has succeeded in producing a photograph of the hand by employing a 6-plate Holtz machine to excite the Crookes tube. The time of exposure was 50 minutes, which, however, is considerably longer than the exposures necessary with the induction coil. The influence machine would, in some respects, be more convenient as an exciter than an induction coil and battery, and it will be well worth while to experiment with this apparatus with the view of reducing the time of exposure. A simple form of vacuum tube has been described by Dr. Pupin and Dr. Morton in American journals, resembling in shape an ordinary incandescent lamp, but having the carbon filament replaced by an anode, and a small disc of tinfoil glued on the outside of the bulb to form a cathode. From the cathode a cone of cathode rays is projected inside the bulb forming the usual fluorescent spot, where it strikes the glass on the other side. The electrodes of this tube are connected up to the outer coatings of a pair of Leyden jars excited by an influence machine. Dr. Morton, unlike other experimenters, finds his tubes too powerful; it appears to be dangerous to bring a sensitive photographic plate, however well protected, into their neighbourhood. He says*: "The Röntgen rays thus produced are of extraordinary power and intensity. They blacken sensitive films deeply, they penetrate metallic objects with even too great intensity for near exposure, and the trouble I have found in securing satisfactory pictures is in reducing the time of exposure and lengthening the distance, rather than the contrary."

That there should be a struggle for the honour of inventing so wonderful a Röntgen tube was to be expected, and a very pretty quarrel on this question between Dr. Pupin and Dr. Morton may be read in the pages of our contemporary, *Electricity*, N.Y. Dr. Morton accuses Dr. Pupin of having seen the tube in his (Dr. Morton's) laboratory, and afterwards describing it as his own. Dr. Pupin disclaims any credit for the invention, since it was well known even before it entered into the head of Dr. Morton to conceive it. Dr. Pupin admits having seen the tube in Dr. Morton's laboratory, but hints that the "learned therapeutist" did not understand its action or how to use it. The extraordinary performances of the "learned electro-therapeutist's" tube had better for the present be received *cum grano salis*.

The difficult problem of choosing a name for the new process has not yet been solved. It has really now become a pressing question, and the parent Professor Röntgen ought to be appealed to. The attempts made by self-appointed sponsors have hitherto been mostly unfortunate. We have been offered the barbarous hybrid "shadowgraphy," the question begging "cathodography," the harsh and undistinctive "sciagraphy." Mr. Justice Wills, regarding the X rays as the antithesis of light, derives from σκοτος darkness, Great Scot! "scotography."

Mr. A. W. Porter, of University College, writes to *Nature* in support of the views of M. de Heen, that the X rays proceed from the anode, not from the cathode. Mr. Porter says that this is undoubtedly true for the bulb which he has used throughout his experiments on the X radiation. In this bulb, the negative electrode is concave, and the negative stream is thereby focussed to a point on the anode, which is a platinum disc placed near the centre of the bulb. By means of a radiograph of concentric zones of tinfoil, Mr. Porter has shown that the actinic rays proceed from the anode disc. This probably depends on the accidental circumstance that in Mr. Porter's tube the spot where the cathode rays strike is on the anode. Prof. Hicks, by taking a pinhole photograph of his tube, has arrived at much the same conclusion. He points out a curious fact, that the X rays appear to proceed only from the side of the anode disc next to the cathode, much as if they were produced by the splash of a jet from the cathode. He says it is difficult to account for the effect "on the supposition that the rays are due to waves generated at the point of impact. We should expect, in this case, the action on the plate to increase with the visual angle of the anode disc, as seen from points on the plate. On the other hand, certain further experiments seem to show that the action is not in all respects similar to the splash of a jet." Prof. Hicks recommends for photographic purposes a tube with a curved cathode converging the streams on to a small plane anode, remembering that the strong field is on the cathode side of the anode. Negatives of remarkable definition have been obtained with this tube, when excited by a coil of 2½-inch to 3-inch spark, the exposures being comparatively short.

Of the same type as the tubes of Prof. Hicks and Mr. Porter is the new "focus" tube which we describe in another column. This tube has been worked out in the laboratories of King's College, and is so great an improvement on previous tubes for rapidity of exposure and clearness of outline, that it is rightly considered to be the greatest advance in X ray photography that has been made since Röntgen announced his now world famous discovery. We may well be proud that this is a home product, and that for once a good thing has been brought out which is not made in Germany.

* *Electrical Engineer*, N.Y., p. 187.

WATER TUBE BOILERS.

Writing to the *Engineer*, Mr. C. Brown, of Basel, comments on the figures given in Mr. Patchell's paper on superheating from a point of view entirely misleading, so far as he draws erroneous conclusions as to Mr. Patchell's object in presenting the paper. Mr. Brown shows that whereas the water tube boiler with an original heating surface of 1,827 square feet only evaporated 3,457 lbs. of water at the rate of 1·9 lb. per square foot, it was made to evaporate 5,125 lbs. by increasing the surface to 2,182 square feet, or at the rate of 2·35 lbs. per hour per square foot, and finally by the aid of a fan draught the evaporation was raised to 8,293 lbs., or 3·6 lbs. per square foot. This he very truly points out is less than the evaporation of the Lancashire type of boiler. The forced draught locomotive type will give 8½ lbs., while tubulous boilers of the Thorneycroft type will give 20 lbs. of evaporation. All this may be so, but Mr. Brown overlooks one fact. The water-tube boiler has in an equal floor space very much more heating surface than the Lancashire boiler, so that the smaller evaporation per square foot of heating surface does not necessarily imply a smaller rate of evaporation *per square foot of floor space occupied*, and it is only fair to the water-tube boiler to remember this fact. But Mr. Patchell did not advance his figures in any sense as an advertisement of any type of boiler. He found himself, we may take it, at a station where there were boilers already in place, and has done his best with the materials at hand. He does not so state it, but we may gather from our own experience that in trying to get more steam out of his boilers, he got instead a good deal more water. The priming qualities of the water-tube boiler have been much argued upon both *pro* and *con*, and the pith of the paper consisted, so far as we could read the portion specially applicable to the author's own station, simply in the statement of certain facts as to power now possessed by virtue of the superheater of forcing the water-tube boiler to nearly three-fold its chimney draught capacity, and dealing with the 58 per cent. of priming water present in the output and yet sending dry steam to the engine. Mr. Brown roundly condemns all water-tube boilers. The worst of all he states is the Belleville, which has been experimented with on such extravagant lines by the Admiralty in the new cruisers, and we think unjustifiably so in face of the strong evidence against the type and the little evidence in support. As to the coefficient of evaporation per unit of heating surface, we think this is always allowed too much weight in arguments on boilers. Evidently Mr. Brown thinks that adding heating surface to a boiler will add to its evaporation quite irrespective of the grate area. He ought to halve the length of a Lancashire boiler, and keep up the same grate surface, then he will be shown how very much more important is grate surface than heating surface. Indeed, the Lancashire boiler with its superior evaporation, as compared with water-tube boilers having a double ratio of H : G, is sufficient to show this. Mr. Brown asserts that the water-tube boiler, and its fellow the Belleville, have all disappeared from the manufacturing district of Alsace, that home of fuel economy, and we are fully aware that, contrary to our contemporary's note appended to Mr. Brown's letter that water tube boilers have found favour with English engineers, there is a very strong feeling against them among engineers. What feeling there is in their favour appears to be grounded on their small water capacity, which enables them to be quickly got to work should a sudden call be made for more steam, but this very shortness of water capacity is a serious disadvantage as regards steady steaming, and we think, so far as electrical works engineers are concerned, that they would be rather inclined to use boilers of a steady description, but with the additional aid of a proportion of water tube boilers for the special occasions named, as indeed has been done by Mr. Gay in the Islington station, where the majority of boilers are of Lancashire type, and the minority are of water-tube type for quick movement.

In condemning the water tube boiler, Mr. Brown ought not to have overlooked the grate surface, and the coal consumption per foot of grate. The addition of the superheater rendered it possible to increase the coal from 11·3 to 15·5 lbs. to the foot, and then by forced draft to 29·3 lbs. To us these are the most significant when taken with due regard to the facts of the tests. Even 29·3 lbs. is not a particularly great rate of combustion, but its significance is marked in contrast with the rate of 11·3, which we may assume to have been the safe rate practicable without the superheater tubes. Mr. Brown quite overlooks these figures in his anxiety to get at and condemn figures which have a real value to anyone who can understand them, and is not anxious to attach wrong motives to the reader of the paper. The whole question of boiler capacity turns on the ability of the various types to give dry results at combustion rates of not less than 20 lbs. per square foot per hour. It is quite possible that at high rates of combustion the action in the inclined tubes of a water tube boiler will be much improved. But if the improvement is accompanied by priming, its value is lost, and the value of the superheater comes in at the point where the priming is dealt with so successfully as we now know it can be.

ELECTRIC ELEVATORS, WITH DETAILED DESCRIPTION OF SPECIAL TYPES.*

By FRANK J. SPRAGUE.

(*Concluded from page* 295.)

Safeties.—Of course, the vital question to be be considered in any elevator system is that of safety. In that respect, I think, we are amply provided. Safeties may be considered under two heads :—

First, those on the car, and second, those on the hoisting machine.

On the car we use a special centrifugal which is attached to the lower section of the car frame.

It consists of two long levers, short-fulcrumed at the sides of the car and operating clamping jaws which run in close proximity to the car rails, but normally out of contact with them. The inner ends of the levers overlap, and in action are pressed apart by a very powerful spring under compression. When out of action, these levers are drawn together, the spring is put under compression, and the system locked by a trigger. Near the trigger is a centrifugal governor, operated by a standing rope, which at a determined speed releases the trigger, frees the levers, and the safeties clamp the rails with a pressure of about 16 tons. This safety can be released from the inside of the car.

In the car, as has already been described, there is an automatic stop contact which operates to bring the regulator to the stop position and the car to rest in case the conductor removes his hand from the controller because of crowding, accident or carelessness.

On the hoisting machine there are a number of safeties. One which is perfectly apparent is due to the fact that the crosshead is moved by a screw with a heavy armature on the end of it, which is driven through the medium of a nut by a car of limited driving capacity. The screw itself is of forged steel, under tension and torsion strains, with a safety factor of at least 20 to 1.

The hoisting nut, as already described, is hardened by a specific process which makes its wear very limited. In addition to this, there is in the nut system what is called a "safety nut." Normally, this is out of contact with the thread of the screw, but it is secured to the hoisting nut, and should any accident happen to the latter, breaking its hold on the screw, this safety nut, the threads of which interlock with the screw's threads to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut, and securely grip the screw. This would put the elevator out of operation, because the friction between the nut and screw would be greater than the friction of the travelling crosshead, and it would act simply as a collar on the screw.

The nut system has, in addition, another function. Since the hoisting nut is only held from revolving by its friction against the crosshead, when the nut gets to the upper limit of its travel, the safety nut meets a solid collar on the screw,

* Paper read at the American Institute of Electrical Engineers, New York and Chicago, January 22nd and 29th, 1896.

which stops its travel, causing it and the ball-bearing nut to revolve with the screw, without, however, necessarily stopping the motor, and leaving the travelling sheaves to be stopped simply by the weight of the car.

There is still another function performed by the nut system, that of a slack cable device. If for any reason the car in descending, when, of course, the nut is driven along by the screw, meets an obstruction, the pressure on the nut being instantly reduced, it recedes slightly, allowing the springs between it and the safety nut to expand, throwing the latter into back contact with the screw threads. The nut system then instantly grips the screw, revolves as a collar, and consequently acts as a check against any marked movement of the crosshead, corresponding to a free fall of the car on the ropes.

Assuming, however, the condition of a perfectly free release from all operative safeties, there is a limit to the rate of revolution of the screw, and in any event there is a rubber buffer at its lower end which would cushion its stop, so as to prevent any injury.

Besides the lower limit switch, which has already been mentioned, which puts an increasing retarding force on the motor, there is an upper limit switch for cutting off the current; this is a self-cleaning lock switch, operating in both directions, and moved by a roll on the crosshead. It cuts off the current in hoisting in the upper limit, and allows the brake to come on. On the reverse movement it is automatically closed.

I have already mentioned the governor on the machine, which is called a "monitor centrifugal." This is for operating the brake when running too fast. In hydraulic elevators there is no speed-operated device in case of fast running, except the centrifugal on the car, and this is frequently set so much above the normal speed on account of the annoyance of having it operated by a temporary excess, as oftentimes to be useless when actually required. The monitor centrifugal does not throw the machine out of operation, but simply slows it up to any desired speed, and then allows the operator to resume control.

The dynamic action of the machine is made use of in still another way by the introduction of an "automatic choking circuit" and switch operated by the same circuits governing the main brake. It is in constant play, and closes the circuit around the armature and its series coils through a rheostat under any of the following circumstances:—At each stop from up or down; when running down fast enough to work centrifugal on the machine; on failure of the hoisting current, or on failure of the line current.

So positive is the control over the motor, no matter whether it be operating to hoist the car or retard it in going down, that the brake band can actually be removed and the car still controlled, and even with the brake in normal position the change from one position to another can be made so promptly that it will remain inactive.

Such is the machine which has been developed during the past three years, and whose first application in a large battery in the Postal Telegraph Building seems destined to have the same effect on the elevator industry that the plant at Richmond has had on the railway industry. It is only permitted to me, of course, to make the briefest allusion to this, but as illustrating in some degree the extent of this industry, buildings of from five to 21 stories in height are being equipped with batteries of from one to 26 machines of various types, and the business of a single company employing some two or three years ago a handful of men, now demands a constantly increasing force already numbering nearly 500.

ELECTRICITY OR STEAM LOCOMOTION.

"Semi-informed" is the characterisation awarded by W. Baxter in the *Electrical Engineer* (New York) to those engineers who, seeing the success of electrical tramways, have reasoned from the particular to the general, and foretold the speedy end of steam locomotives. One prominent engineer foretold success to electricity because he said it would be cheaper, being generated by superior engines from cheap coal at the rate of 2 lbs. per horse-power-hour, instead of by high pressure engines using 6 lbs. per horse-power-hour of dear coal. Mr. Baxter says, however, that if electricity is to depend on coal differences, it may as well give up the contest at once, for even if the economy is as great as claimed, and he seems to think it may be, the fuel cost of railroad work is but a small portion of total cost of running.

The author now endeavours to put forward the case for electricity in a fair and impartial manner, rather than as a biassed advocate making claims that cannot be upheld. He dissents, therefore, at the outset, from the ratio 4 to 1 in fuel consumption, and would change this to 5 to 2, for even the best engines are scarcely likely to run for less than 2 lbs. per horse-power, and he cannot agree that 6 lbs. is a fair rate with which to saddle the locomotive.

He is dealing with American locomotives, which, as a rule, are less economical than English engines, but he warns against taking the best rates for locomotives as being of general application. Thus we might take the 23 lbs. per mile of the large G.N. singles as a standard. This implies only 1,380 lbs. per hour at a speed of 60 miles, or about 2 lbs. per H.P. hour. But such a figure ignores freight and slow service and shunting engines, which may go as high as 20 or 25 lbs., and, on the whole, he takes 5 lbs. all round as a fair rate with 2 lbs. for stationary engine. One thing he omits. It is argued by some that the locomotive and its tender consume half the power generated in the cylinders. Whether this be so or no, there is no doubt but that they consume a good round proportion of the total power. With electricity and motor cars, carrying no more than their own load, it is clear that the engine and tender traction will be abolished, and he might have urged this fact in favour of electricity. He does not set it against the line losses, for he takes due account of these, and thereby brings down the ratio of fuel to 3 to 2 on a basis of 60 per cent. conversion efficiency. Thus the cost of electricity is to be only two-thirds that of locomotives, and he might, as above pointed out, have brought it to one-half, or less.

At the mines coal costs 95 cents to $1 per ton. A very cheap grade perhaps only costs 25 cents. Railroads not in the coal districts have to pay from $1·50 to $3, or an average of $2·25, the cost of carriage being alike for all grades, so that the cheapest coal would average $1·50. With the dear and cheap coals apportioned to the locomotive and the stationary engine, the fuel cost ratio is 44·4 for electricity, against 100 for locomotives, and this, without the advantage we have shown, has been omitted. With 30,000 miles per year per locomotive, at an average of 80 lbs. per mile, the coal saved would amount to $1,300 annually, and this would not pay for the application of electricity to established lines, but might pay where the lines were new, and electricity was originally intended, the question depending upon the relative cost of installing the two systems. Electricity, with its numerous power stations, feeders and lines, at first appears likely to be very much more costly; but on the other hand, motors are very much less costly than locomotives. This is a comparison engineers can make for themselves. A locomotive will cost, say, £2,000, and will, at a pinch, develop 1,000 horse-power; but, ordinarily, 500 is a considerable output. To do the work of one locomotive we should need to have a motor capable, we will say, of half this power. Will a 250 H.P. motor cost very much less than the equivalent locomotive power? From a price list before us, a 4 H.P. continuous current motor seems to cost £50, and the increment is at the rate of £5 per H.P. With accessories, the motor cost will be considerable, even at very much less than £5 per additional horse-power. But, in addition to saving in the motors, there would be needed smaller repair shops, fewer tools, no water cranes, tanks, coal sheds, and other locomotive accessories, and these are estimated to go a long way towards the cost of power stations, lines, and poles; so that, on the whole, the commercial difference might be on the side of electricity on new lines. In this argument, the author neglects one obvious disadvantage against electricity. He does not say how he is going to perform his shunting and yard work. Can electricity displace the locomotive in a yard? If not, then what becomes of the boasted saving in water cranes and tanks, and will there not still remain the yard locomotive consuming its 20 or 25 lbs. of coal, whilst the express locomotive, with its low fuel consumption, is abolished.

The ratio of coal cost to total operating expenses on various railways is tabulated. It varies from as low as 6·1 per cent.

to as high as 18·1, and averages about 10 on the lines given in the table, being heaviest in the lines with greater proportion of freight traffic or most distant from coal pits, and the conclusion is drawn that it is in freight service where coal is a more important item, that electric traction is the more likely to be successful, especially as freight trains are so much side tracked to make way for passenger trains, and coal is all the time being burned to waste.

It is argued that an electric motor can make a bigger mileage than a locomotive. This, of course, supposes separate motor vehicles for freight, and disposes of the saving due to motor cars. Fewer electric motors would thus do the work of a given number of locomotives. The author has done his best to be impartial, and has succeeded only in drawing a doubtful conclusion. Yet he has neglected the serious item of yard work, and cannot be held to have established the case for electricity in main line work. Electrical traction as we now know it, may be, in the comparison with steam locomotives, paralleled with the similar question of water-power *versus* steam. The water is cheaper, but it requires heavy station work; heat is wanted for other purposes, and there must be a steam engine for frosty or dry seasons; and so it happens that steam is after all the cheaper power.

There is no argument in favour of main line electrical traction to be drawn from the success of electricity in displacing horses on tramways, and it is only in the very exceptional case of a conceivable direct express passenger service that electricity can at present be considered applicable to main line work. If there is one main line more than another to which electrical traction might be applied, and where it would insure increased traffic, if not decreased expenses, and where there are no difficulties as to yard work, that line is the underground of London. Everything points to electricity as the correct motive power, and there can be no two opinions as to the traffic increase that its application would secure. The lesson to be learned would be valuable for future work. Even if the motive power proved more costly than at present, there would be a sufficiency of increased receipts to meet this, so that the risk would be *nil*, and would be faced by any really progressive board.

RECENT IMPROVEMENTS IN AMERICA AND EUROPE IN THE STORAGE OF ELECTRICITY.*

By HERBERT LLOYD.

During the ten or fifteen years that cover the period during which storage batteries have been more or less in commercial use, the electricians of this country have been divided into two distinct classes; and two only—those unalterably opposed to their use, and the other class firm believers, and, one might say, enthusiasts.

In Europe one gets the impression from an acquaintance with electrical engineers—in England, France and Germany, at any rate—that accumulators are considered an essential feature in almost all electrical work. Some engineers are greater advocates than others of the system, but all are apparently believers. When it is borne in mind that the discovery of secondary currents was made in 1801, and even a lead accumulator was made in 1803, it seems strange that it has only been within the last five or six years that a lead accumulator has been proved to be a commercial piece of apparatus.

A really practical storage battery was, of course, made by Planté in 1860, and another step was made in 1881, when Faure and Brush developed the battery plate made by the application of already formed active material. In about 1890 the chloride plate was developed, differing both from the Brush-Faure and Planté. This plate depends for its usefulness on the peculiar and beautiful crystalline structure of the cast material. Although the present state of the art shows more than one excellent form of positive plate, there has nothing yet been produced comparable with a chloride negative plate. Its capacity for weight and ability to withstand both the use and abuse which a battery, to be successful, must withstand, is almost phenomenal. In England and France the companies doing by far the greater portion of the business use no negative but a chloride negative, and in those countries there are no fundamental battery patents in existence to-day.

In England one is impressed not, perhaps, with the magnitude of the battery installations, but by their number. Private house plants run by gas or gasoline engines are simply abundant. Central station batteries are being installed about as fast as central stations are built, which in England is comparatively slow. In Manchester, London, and Belfast, Ireland, very large central station batteries have been installed within the past year.

Electric traction, of course, in England, and on the Continent, is carried out on a very small scale, either trolley or battery traction. In Birmingham, England, a storage battery road has been in operation for some six or seven years, and has been the experimental ground for almost all makers of battery, and the service rendered was, of course, not the most satisfactory. A little over a year ago the Chloride Syndicate got a contract for the equipment of all the cars of this line with their battery, and with the experience of their allied company in France at their back, they have been entirely successful, giving service satisfactory to the railroad company, and doing the business at a profit to themselves.

In France, the Madeleine and St. Denis Road has now been in operation over three years, running about 30 22-foot cars, double decked, seating between 50 and 60 people. These cars have run up to this time between two and three million car miles, and the company have every prospect of gradually replacing the horse cars in Paris, in the face of the most terrific competition with steam motors, compressed air motors, gas motors, and I do not know how many more. On this road some very good results have been obtained in what they call "recuperation." A very careful test, covering 100 trips, about 11 miles each, gives the following results, according to figures given by M. Sarcia:—

The car while descending a 10 per cent. grade could recover 57 per cent. of the energy expended in ascending it; on a 4 per cent. grade a return of 42 per cent. is effected, and on a 2 per cent. grade 23 per cent. On a 1 per cent. grade the recuperation is zero, with a traction coefficient equivalent to 22 lbs. per ton. If the traction coefficient could be reduced to 11 lbs. per ton, there would be recovered, in utilisable form, according to their experience, 63 per cent. of the energy expended in ascending a 10 per cent. grade, and with that low coefficient of traction 23 per cent. could be recovered down a 1 per cent. grade. If the traction coefficient was zero on the level, the car having no dead resistance, either electrical or mechanical, there would be recoverable on descending a 2 per cent. grade 70 per cent. of useful energy, the efficiency of the battery being in this case 70 per cent. An electric mountain railroad recently built on the Isle of Man, on which the grade is almost a uniform 12 per cent., is equipped with a trolley system having a battery in the power-house. On this road the car descending the grade delivers back to the battery over the line about 33 per cent. of the energy which it consumes in ascending, so that it is beyond question that these applications should be taken advantage of wherever it is possible, the economy being so apparent.

The cars that have been in operation on the Paris roads for three years are of the old type, with the batteries placed under the seats, but new cars are being equipped with one box of batteries suspended under the car, thus eliminating the many disagreeable features incident to locating the batteries under the seats. The practice heretofore has been to run 33 miles on one charge, with a battery weighing about 3 tons. With the newer cars the battery weighs about 1½ tons, and runs one 11-mile trip on a charge, although under good conditions it would be capable of two such trips. In the new cars no mechanical brake is used at all, the braking being accomplished by the charging of the battery, although for the final stop the motor armatures are short-circuited. The motors are shunt wound, always used in multiple, and in starting, resistance is inserted in the armature circuits, which is gradually removed to increase the speed until it is all out. To attain full speed, the field is weakened by inserting resistance.

The matter of charging the batteries on this road has

* Read before the New York Electrical Society, January 29th, 1896.

received very careful attention, and has been modified at various times. Originally, when the road was started, the battery was charged at a constant potential, 108 cells being thrown on to a 260-volt bus. Under these conditions the charging current commenced about 150 amperes, but gradually decreased, so that at the end of charge it has reached about 10 amperes. They now use two busses. The battery is thrown on to a bus equivalent to 2·4 volts per cell, where it is left for three hours, or until the current has fallen from 90 to about 30 amperes. At the end of the third hour the battery is thrown on a higher bus, equivalent to 2·55 volts per cell, on which the charge is completed in from one to two hours, or more, thus avoiding the use of resistance.

The most interesting feature in connection with the operation of this road is the method of re-pasting the positive plates. The positive support plate is grooved, and made of an alloy, upon which there is very little electrolytic action, and by a special process the peroxide which has been deposited on the bottom of the jars in a worn-out cell is re-pasted into these grooves. Two men are employed re-pasting, and are able to keep some 30 cars in continuous service, so that the cost of this portion of the operation is wonderfully small. I saw a number of these grids which had run between 25,000 and 50,000 miles, showing no evidence whatever of depreciation. The casting of these grids is carried on by a special process, by which the alloy is cast under very heavy air pressure, which method is protected by an original American patent, the French patents of which have been assigned to the French Chloride Company.

The Sector Clichy, a five-wire station at Paris, has two very large batteries installed last fall, one-half being manufactured by the Chloride Company, the other half by the Tudor Company. This battery, which is now complete, is probably one of the largest in the world.

In Germany the Tudor Company, with works at Hagen, have, during the past eight years, installed over 5,000 plants.

A most interesting application of storage battery has just been made by them on the street railroad of Hanover, where the cars are propelled by storage batteries within the city limits, and run by the trolley outside, the battery being charged without removal while the cars are running through the outskirts. Forty-four cars have been installed on this plan. Battery cars are also running in Berlin, Hagen, and other German cities, and also in Vienna. Up to the past year, the German Tudor Company has devoted its attention almost entirely to lighting work, but in Germany and France there is a feeling that the time is ripe for the development of storage battery traction, and within the next year a great deal will be accomplished in this line.

It is well known that in this country patent litigation has long interfered with the development of the storage battery business. Something over a year ago one strong company acquired all the patent rights of the contending companies, thus removing all question on the score of patents. This company, being also allied with the three strongest European companies, is able to take advantage of every improvement that is made either here or abroad, and can therefore produce the best battery obtainable.

Some months ago the New York and Harlem River R. R. Company, of New York, decided to place two storage battery cars on its Madison Avenue line, to be operated through the winter, in order to determine whether or not the system has been brought to a stage of advancement which would warrant the equipment of the entire road.

In the cars run from Eighty-fifth Street to One Hundred and Thirty-fifth Street, the batteries are suspended between the axles, on the car truck, entirely independent of the car body. In fact, so independent are the trucks, that they have been run alone, without any car body on them at all. The cars have standard Stephenson bodies, 10 feet long, and standard Peckham trucks.

Sixty cells of nine-plate traction type chloride accumulators, capacity 400 ampere hours, are placed in a tray about 4½ feet square, and connected up solidly by lead burning, in two series of 30 cells each. This tray is placed on a small transfer truck, running on a narrow gauge track in a pit 8 feet below the level of the street car tracks. An electric elevator is utilised to hoist the tray full of batteries, together with transfer truck, up between the street car rails into position on the street car truck, where the tray is automatically locked, and the elevator, with transfer car, withdrawn. Large contact shoes on the car, kept in place by steel springs, engage with contact plates on the trays, as batteries are raised, so that the connections are made automatically.

Each car is equipped with two G.E. 800 motors, supported outside of the axles, and two "K" controllers. A cable system will be applied to the shifting of the transfer cars in the battery pit.

The special advantages of this particular method of battery application include the features before mentioned, of low steps for cars, and the standard height and width of seats; an entire independence of car body permitting of a change, as, for instance, from open to closed car bodies, and *vice versâ*, together with an entire absence in the car of odour from the battery electrolyte; a compact, easily handled tray of batteries; utilisation of space below and above the street car floor, without occupying 1 square foot of the car shed proper.

In the past batteries were made of a practically uniform type of small size, capacity being obtained by putting many series of cells in multiple. Now large units in batteries have come into use, just as large generating units have, an example of this being the battery installed in the Boston Edison Company's station, where each cell weighs about 3 tons, capacity 8,000 A.H., or 16,000 A.H. at 140 volts, with a maximum output of 8,000 amperes.

The size of cell should be increased almost indefinitely. Batteries are now constructed specially to suit the work for which they are intended. Until recently in isolated plants, such as private houses, 150 ampere-hour cells in glass jars were generally used, as many as eight of such series being installed in one house. A private house plant has been recently installed in this city, with one series of cells of 2,500 amperes each, and in the last three months half a dozen similar plants have been installed, varying in size from 1,000 ampere-hours up.

Within the last year the question of electric train lighting has come up with considerable force, and cars are now running between New York and Chicago lighted by storage batteries alone, without any systems for operating dynamos and engines on the train. Train lighting in this country is a different matter from train lighting in Europe. In Europe a few 8-candle power lamps to the car are considered sufficient. The cars just referred to as running between New York and Chicago have 44 16-candle power lamps. A train consisting of five or six such cars requires a lighting plant of quite serious proportions.

Experiments are being made with more or less success with small dynamos driven from the axle of the car; a moderate-sized storage battery is used to maintain the lights when the speed of the train falls below some 20 miles an hour. A car so lighted is now running satisfactorily between New York and Washington.

Perhaps the application of storage batteries which will arouse greatest interest is that of stationary batteries applied to equalising the load on trolley lines. Two or three plants of this character have been installed within the past year. In a road of considerable length, the application of a storage battery would save in feeder copper a great deal more than its own first cost, and the contingent advantages to be derived from the operating of the generating plant at a practically constant load are too well known to require reiteration.

The application of batteries to electric elevator installations shows as great or even greater advantages. As Mr. Sprague stated in his paper before the last meeting of the American Institute of Electrical Engineers, to operate six elevators without a battery would require a 120-kilowatt generating plant, while the average load would be but 35 to 40 per cent. of this. With a properly constructed battery, he states that the direct plant could be reduced to 60 kilowatts, or even to 50. A battery was installed last Fall in connection with the elevator plant in the new court house at Minneapolis, and the curves shown prove the effect. A similar plant is just being installed in the Chicago Board of Trade Building for the same purpose.

In this class of work, it is necessary that the battery should be capable of discharging at rates which would completely exhaust it in from half an hour to an hour. These discharges, of course, are not long continued, and the batteries as now constructed are not injured by this treatment. Up to two or three years ago a 10-hour rate of discharge was considered a maximum rate. Recent improvements in the

manufacture of storage batteries have been entirely along the line of producing a battery which is capable of discharging in from one to three hours, although the cost has not materially decreased, if capacity alone is considered; but when discharge rate is considered, the cost has been greatly reduced, since a battery which can be discharged at five times its normal rate will replace one five times its size of the old type.

One feature of the battery business which has received a good deal of attention recently is the specific gravity of the electrolyte. The curves shown are very interesting, as they show how the capacity of a cell varies with the density of the electrolyte; the plates being respectively $\frac{1}{4}$ inch thick and $\frac{1}{10}$ths inch thick. The thicker plate has a maximum capacity when the density of the acid is about 1·275; the $\frac{1}{4}$ inch plate has a maximum capacity when the electrolyte is about 1·240. It is very noticeable how rapidly the capacity falls off on either side the maximum point. These curves are taken from two chloride cells, the volume of the electrolyte being sufficient to prevent any great change in specific gravity. The mean volts on discharge shown in the upper curves rise almost regularly as the acid density rises.

The rate of discharge being the same per pound of active material, the discharge rate per superficial area is therefore approximately 40 per cent. greater with the thick plate than with the thin.

The battery just being installed in the new Edison Station at Twelfth Street, New York, consists of 150 4,000-ampere-hour cells. The positive plates of this battery somewhat resemble the "Tudor" type, the negatives are the "Chloride" type. They are installed 75 cells on each side of the three-wire system; the 25 end cells on each side are used as regulating cells, being connected by copper bar to four regulating switches, two on each side, so that the battery can be discharged at different potentials. The battery has a capacity at 10-hour rate of 4,000 ampere-hours on each side, at a three-hour rate of 3,000 ampere-hours on each side, and at one-hour rate of 2,000 ampere-hours on each side.

The erection of the battery in two tiers, the upper tier of iron framework, is, perhaps, new in this country. The insulation of the cells is effected by a special type of oil insulator, which makes this method of erection quite safe. The battery is installed in a room approximately 20 feet by 40 feet, which is, I think, the smallest space in which a battery of equal capacity has yet been placed.

Another Edison station recently equipped is in Lawrence, Mass., where a smaller battery, with capacity of about 1,500 ampere-hours, is in use; this battery is discharged completely in two hours between four and six in the afternoon, during the peak of the load.

The motocycle contest in Chicago has attracted a good deal of attention to the question of electric road waggons. The carriage which secured the gold medal, first prize, was built by Caffrey, of Philadelphia, and weighed complete 1,650 lbs., including a battery weighing 664 lbs. The battery consisted of 44 50-ampere-hour chloride cells; the waggon was equipped with two $1\frac{1}{2}$ H.P. Lundell motors, with series parallel controller.

This carriage is capable of running from 25 to 30 miles on one charge at a speed of 10 miles an hour; it could attain a maximum speed of about 20 miles an hour for one hour, carrying four people. The two front wheels of the carriage are driving wheels, and it is steered by the rear wheels. On the first speed with an average discharge of 5·6 amperes, or two-thirds of an electrical H.P., a speed of 4·6 miles was attained, and at this speed the carriage would travel 46 miles on one charge. On the second speed, running at 10 miles an hour, it required 13·2 amperes, or one 56-100 H.P., covering by this speed about 30 miles on one charge.

This carriage has been sold and shipped to Germany to be used as a model for building similar ones over there.

This question of electric vehicles is attracting the attention of the large carriage and bicycle manufacturers, many of whom are building such vehicles, and with a battery such as is now produced capable of very heavy discharges, and with good roads, it would appear as though the business would soon assume large proportions.

The use of electric launches is growing steadily, but not as rapidly as other applications. In this work light weight is not so important as for carriage work, but batteries for this work must have large capacity, as it is often necessary to make long runs before facilities for re-charging can be obtained.

The improvement in storage cells for this work is shown in the fact that the batteries on the launches which ran for three months at the Atalanta Exposition did not cost 1 cent. for repairs, which was not the case with those used at Chicago, at the World's Fair. The battery used at Atalanta was the chloride type.

CENTRAL STATION WORKING.

In continuation of our remarks on central station working at present appearing in the *Electrical World*, of New York, we have to deal with a contribution to the series by Mr. James B. Foote. This gentleman endeavours to treat of various points in the efficiency of the service which might be improved, and the working expenses decreased. The first point that he considers is the longevity of incandescent lamps, and he looks with favour upon the tendency to sacrifice the length of burning of a lamp to a high efficiency lamp with a brief existence. He next takes up the question of the efficiency of the engines, and he seems to be doubtful as to whether the engines should be triple expansion or two cylinder compound. In Mr. Foote's station he had two triple expansion engines which consumed about 18 lbs. of steam per I.H.P., the steam pressure being 140 lbs. In order to see if there was any advantage in using the triple expansion engines, as against the two cylinder compound type, a third engine was built exactly the same as the triple, in every respect, except that they left out the intermediate cylinder. The engine then was a two cylinder compound condensing engine, the length of stroke and number of revolutions being the same.

These engines were of the plain automatic flat valve balanced type, and had all the valves on the governor, a point which Mr. Foote thinks of great importance, but which we think introduces complications which are not desirable. It is interesting to note that the results obtained by the compound engine are said to be practically the same as with the triple expansion engine, when the conditions of working, as regard steam pressure and load, were the same. It is obvious that these results are inaccurate, and the reason we think is apparent, for we have only to refer to the makers of the compound condensing engines to find that they are prepared to guarantee a steam consumption of, roughly speaking, 20 lbs. per I.H.P., and we know of several makers of triple expansion engines who have guaranteed a steam consumption of less than 14 lbs. per I.H.P. The inference, therefore, to be drawn is that the performance of Mr. Foote's new compound engine left nothing to be desired, so far as economy of steam consumption was concerned, but the same cannot be said of the triples, which we think were somewhat extravagant, the reason probably being that after constant use of six or seven years, the setting of the valves might have become altered, leakage past the piston due to wear, and above all the proportioning of the size of the cylinders to the work which had to be done may not have been so perfect as in the compound.

Mr. Foote's calculations will be gratifying to the makers of the compound engines, but those who manufacture triple expansion engines would not be flattered with the steam consumption, and would no doubt point out that the advantages of having six turning moments per revolution and the working of the steam more expansively were points not to be ignored.

The next point touched upon is insufficiency of chimney draught. The remedy, however, is simple. If one cannot harden one's heart to pull the chimney down and build one large enough, then the only alternative is the employment of a forced draught. It will enable better results to be obtained at a very small capital expenditure.

Next in order is taken the importance of furnishing dry steam to the engine. There can be no doubt upon this point, but this involves a very careful selection of steam piping and fittings, the employment of steam separaters to the engine, and an efficient non-conducting covering for the same, although these points are well known to engineers, and should never require to be dilated upon. It is unfortunate, however, that in too many cases the arrange-

ment, size, position, and covering of steam piping is not sufficiently attended to before it is fixed.

On the advantages of employing feed water heaters, there can be no question, but the method in the article under consideration is not one which can be recommended, although it is not particularly inefficient. To employ the ordinary closed water heater through which the water from the pumps to the boiler is passed and supply the same with steam from the receiver of the H.P. and L.P. cylinders is not to be recommended, except in economy in first cost. In England we look upon this arrangement as obsolete, for very much better results can be obtained by placing in the main flue a tubular water heater which receives its heat from the waste gases passing through the main flue to the chimney, and the results obtained are eminently better than those which can possibly be attained by the method just referred to.

Before leaving the engine room there are several small points which ought to be mentioned, points which are apparently small in themselves, but which affect the economy of the working to a very large extent if neglected. Among the most important of these are the keeping of the valves and glands tight, preventing leakage of the steam from the steam pipe, and keeping all the blow-off cocks perfectly tight. These several faults, although small in themselves, when combined, form a serious drawback, for as they are continuous, the aggregation at the end of a year's working very materially lowers the efficiency of the station.

We are quite at one with Mr. Foote in his condemnation of the employment of a common shafting for driving dynamos, as much on account of it requiring considerable power to turn it, as its liability to throw a number of dynamos out of commission and interrupt the supply.

Mr. Foote has confined his article chiefly to the economy of generation, but the remainder of the series will afford ample opportunities for discussing the economies in distribution as practised by the central station engineers in the United States.

AYLSWORTH'S NIOBIUM INCANDESCENT LAMP.

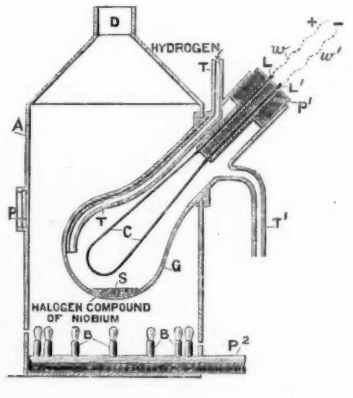
By using the heat of a Bunsen gas flame to heat a mantle composed of certain infusible rare earths, Auer von Welsbach has succeeded in getting something like eight times more light from the combustion of a given quantity of gas. Evidently, therefore, the amount of heat energy converted into light depends greatly on the emissivity of the substances heated. Many inventors have tried to apply this principle to the incandescent electric lamp, for there is, in this case, also a great possibility of improvement, since the present electric glow lamp converts into light only 5 per cent. of the total electric energy supplied to it. The principal substances used by Welsbach are oxides of Lanthanum, Thorium, Zirconium, Yttrium, Niobium, Cerium, and Didymium. According to the oxides used, the colour of the light is different. For instance, according to MacKean, 40 per cent. of oxide of lanthanum, 20 of thorium, and 40 of zirconium, gives a white light; 40 per cent. La., 28 Th., 30 Zr., and 2 of Ce., gives a yellow light; and 50 per cent. La., 10 of Nb., and 40 of Th., gives an orange light. The ordinary mantle used for domestic light emits, as a rule, too great a proportion of green rays, and produces a very disagreeable ghastly effect, which, it is hoped, may never be imitated by the electric glow lamp. It is evident, however, by properly choosing substances to be used to improve the emissivity of the carbon filament, that a much more pleasant light may be produced.

The most recent attempt to improve the glow lamp on the above lines is that of Mr. J. W. Aylsworth, of Newark, N.J., who, according to the *Electrical Engineer*, N.Y., makes use of such refractory metals as niobium, tantalum, molybdenum, titanium, zirconium, and other metals of the same group.

The method by which the filament is prepared consists in heating a base or support in the vapour of a volatile halogen compound, of the element which it is desired to deposit, and simultaneously mix it with a reducing gas, such as hydrogen.

In actual practice the process is carried out by means of the apparatus shown in the accompanying engraving. As will be seen, it consists of a heating chamber, A, provided with an outlet, D, for the products of combustion. The tube, T, admits the hydrogen gas under pressure, and T^1 conveys away the resultant gases or vapours.

Mr. Aylsworth takes an ore of the metal to be treated—such, for instance, as columbite, a well-known ore of niobium, and treats it by the well-known chemical process for separating the oxides of such metals, and obtains in this manner niobium oxide. After the oxide is thus separated from its ore, it is converted into a volatile halogen compound, by the well-known process of mixing such oxides with charcoal, and heating to a high temperature in a current of dry halogen gas, such as chlorine or bromine. The halogen compound, S, is seen in position in the retaining vessel, G. The retaining vessel and its contents is then submitted to the heat of Bunsen burners, and simultaneously a stream of reducing gas, as hydrogen, is passed through the chamber by way of the inlet and outlet tubes, T and T^1. A sufficient current of electricity is then passed through the conductors, *w*, *w*, and the carbon



or other base or support, C, to heat it to incandescence, without rupture. There results from the union of the hydrogen gas and vapours, arising from the halogen compound, a deposit of the pure metal, as niobium, upon the filament, C. This process is continued until the process reaches the desired thickness.

Halogen compounds of any of the highly refractory metals above referred to, or any of the equivalent highly refractory metals, may be used in place of the halogen compound of niobium, and the pure metals thereof deposited in the manner indicated. Mr. Aylsworth has succeeded in depositing, in this manner, tantalum, niobium, molybdenum, titanium, and zirconium, continuing the process in each instance until the carbon core or other conducting filament is surrounded by the metal.

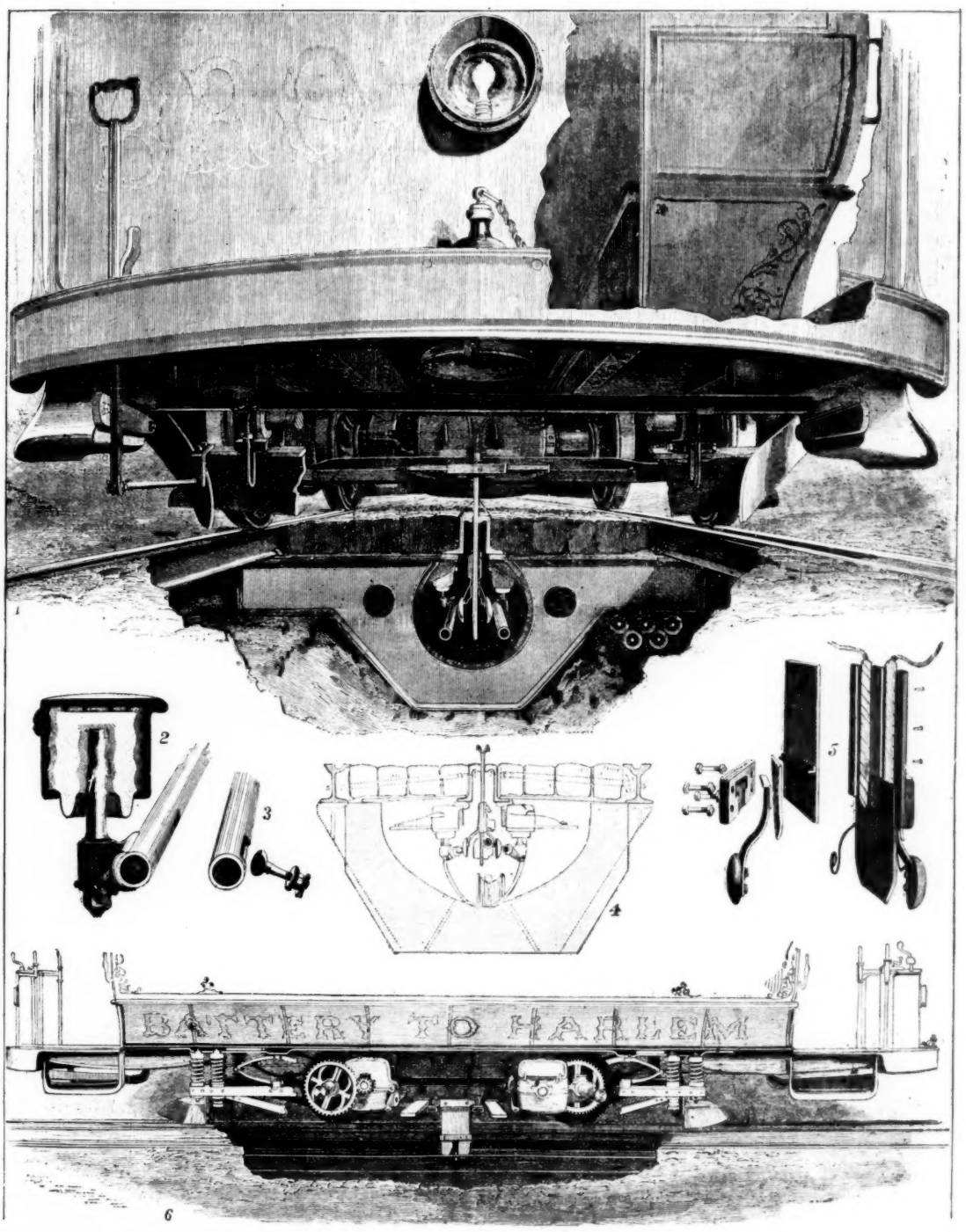
A niobium lamp, prepared in the manner described above, has been run for some months past, and shows very high efficiency and long life.

THE UNDERGROUND TROLLEY STREET RAILWAY IN NEW YORK CITY.

The Metropolitan Traction Company, of this city, having organised and put in operation their highly developed cable traction system, has now gone a step further and installed on underground trolley system on part of its line, with the double view of working the portion of the road now equipped therewith by electricity, and of extending it in the near future to other portions of their line.

For some reason, says the *Scientific American*, the idea of an underground trolley system has been considered almost impracticable. Up to the present time the Buda-Pesth road and a short line known as the Port Rush road, near the Giant's Causeway, in Ireland, are the only two roads which have actually employed an underground electric trolley successfully for any length of time. Great difficulty has been feared from the entrance of dirt, moisture, snow, &c., into the conduit, destroying insulation, bringing about the formation of arcs, and involving other troubles. So true is this that a number of ingenious systems for avoiding these

troubles have been devised and have been operated with more or less success experimentally, although they, naturally, are more complicated than the simple open conduit. The Metropolitan Traction Company has adopted the system of the General Electric Company, which is distinguished by great simplicity, dependence being placed more upon perfection of construction than upon any especial design for its protection from interference with its general working qualities. The



conduit proper is of the typical construction used for the cable roads. This construction has been followed with the object of supplying a conduit for a cable if the electric system should prove unsuccessful or undesirable. Through the conduit on each side the contact bars are carried by hangers. The contact bars are connected laterally with feeder wires placed just under the outer shoulder of the iron casting. In the more recent portions of the installation the feeder bar is a wrought iron pipe 1½ inches interior diameter and 2 inches exterior diameter. The pipe is inserted in 30 feet lengths and bonded at the ends with copper wire connections, bolted into the hanger slots. These pipes can be seen in our view of the cross and longitudinal section of the conduit and also in figs. 2 and 3.

The hangers, of one of which we give a section, fig. 2, depend upon a porcelain cup for their insulation, which cup is corrugated inside and out, and fits into a correspondingly corrugated cast-iron cup, receiving in its central aperture the iron hanger rod, all being secured together by cement. To the lower end of the hanger rod a socket is bolted, and to this the pipe, in its turn, is bolted, the end of the bolt in the pipe passing through a slot 1⅝ inches long, in order to provide for expansion and contraction by heat and cold. The head of the bolt is so shaped that it can be in-

troduced into the slot, when by a revolution of 90° the bolt is secured to the pipe as shown in fig. 3. The hanger bar is 1½ inches thick and 9 inches long, and the lower semicircular socket is attached to it by a swivel joint. This is the construction practically settled upon definitely, subject, of course, to minor changes if anything better can be evolved.

The electrical contact apparatus, termed the "plow," is attached to the car body and is built up of sheet steel, with wood and fibre insulation, its form generally being a parallelogram. When it is remembered that the slot itself is only ¾-inch wide, it will be seen how accurately the plow has to be constructed to correspond thereto in size. Its shank is $\frac{7}{16}$-inch in thickness, giving a clearance of a little over ⅛th of an inch on each side. To construct the shank two sheets of steel, ⅛th of an inch thick, are bolted together, and in the centre and at the ends a central shoulder and end pieces are inserted for keeping them ⅛-inch apart, thus providing two passages between them of this width, and 3 inches long, going all the way down. This shank is 9½ inches wide, and descends well into the conduit. On each side of the lower portion of the shank are carried the contact shoes, which are seen in various views in our cut, especially in fig. 5. These are castings, each being 4¼ inches × 2¼ inches, and ¾-inch thick. A single shoe is used on each side, although as many as three on a side have been used experimentally. They are carried by sheet steel springs 2¾ inches wide, which press them outward from the plow frame, as shown in fig. 5. Under the influence of these springs they are pressed against the conductors with a pressure of about 7 lbs. The upper ends of the springs are clamped in place by bolts, wooden blocks and fibre sheet being used to insulate them from the plow frame.

The exact disposition of these parts is seen in fig. 5. The springs are held in place by compression, and by the hooked upper end, which enters a mortise in the wooden block. The fibre sheet is shown directly back or to the right of the detached spring. The same cut shows a heavy sheet of fibre descending down from the plow shank, and between the springs to prevent any possibility of a short circuit. We have spoken of the channels that extend through the shank of the plow; through these pass copper conductors insulated with mica and tape wrapping (fig. 5), one conductor for each contact shoe. Between the ends of the conductors and the shoes the connection is made by safety fuses, so that if too much current is put on, the burning out occurs at this point.

At the present writing the system cannot be called experimental in the usual sense, as it has operated with uniform success for nearly an entire winter, as well as during the less trying summer weather, and the line is in daily operation, and gives the greatest satisfaction. The Columbus and Lenox Avenue line is operated from a power house at 146th Street, near Lenox Avenue. Here there are installed two multipolar dynamos, class B, of the General Electric Company, which, at 100 revolutions, give a pressure of 300 to 330 volts each, with an output of 1,200 amperes; but in practice they have been speeded up to nearly 150 revolutions, raising the voltage to 525. For each dynamo there is installed a 1,000 horse-power cross compound Allis engine, with Corliss valve motion, exhausting into the open air. To supply the engines there are two Babcock & Wilcox boilers, each containing 100 4-inch tubes, 18 feet long, with 42-inch drums, ½-inch thick, and 23 feet long, and capable of working at 180 lbs. At present cars are run by electricity on this division from below 116th Street on Columbus Avenue, to Lenox Avenue and 146th Street, but ultimately it is proposed to extend the electric system to other roads in the city. The Eighth Avenue road is the next one of the old roads to be equipped. It has been found that the conduits do not accumulate dirt, that the loss of current is not worse than on an overhead trolley, and the conduit has proved to be practically self-cleaning, requiring to be swept out, perhaps, two or three times in a year, the natural flushing of the rain doing the greater portion of the cleaning. It is made, of course, self-draining.

Fig. 4 is a cross section of the conduit drawn to illustrate the relation of the cable and electric systems. It shows where the working and idle cable in the cable traction system are situated, and gives the position of the parts of the electric system very clearly.

Manholes are placed along the line, never less than 250 feet apart. At them are placed sewer connections for carrying off rain water. Over each insulator is a handhole beneath the street paving blocks easily reached by raising a few stones.

Each car is provided with two 25 horse-power motors, with electric heaters and electric lamps, including headlight.

A very noticeable feature about the operation of the cars is their smoothness of operation. They start without the jerk which is so pronounced on the cable roads, and the extension of the system to other roads of the city will be a decided improvement on existing systems. The system is interesting, also, as not using a return grounded circuit, so that electrolysis of water and gas pipes will be avoided.

THE NEW X RAY "FOCUS" TUBE.

A new tube for producing the X rays has recently been designed by one of the professors at King's College, London, which is so great an improvement on anything in this line that has been previously produced, that it will undoubtedly give a great impulse to the practical applications, especially to surgery, of the new photography.

We are enabled by the courtesy of Messrs. Newton & Co., 3, Fleet Street, who are the manufacturers, to give a description of this tube, and also a Röntgen photograph of a hand with a piece of embedded needle, obtained by means of this tube, with an exposure of only two minutes. The clearness and definition of the photograph are much superior to anything we have hitherto seen, and the time of exposure is less than the best previously attained.

The sharpness of the image is due to the fact that the cathode rays are focused to a point where they impinge on a plate of platinum fixed on the anode. The X rays which produce the photograph radiate from this point, and, of course, produce a much sharper shadow of the object being photographed than when radiating from the extended luminous patch on the glass of the tube which has hitherto generally been used. Fig. 1 shows a section of the "focus" tube. The cathode plate, K, is a concave disc of aluminium which

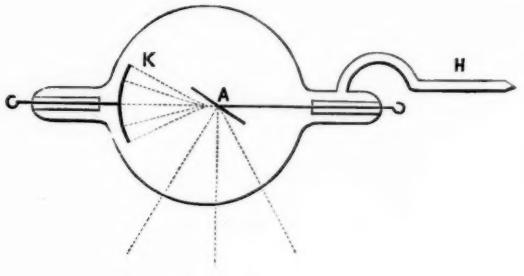


Fig. 1.

focuses the cathode rays at a point near the centre of the bulb. The anode plate, A, is a small piece of platinum foil placed at an angle a short distance beyond the focus of the cathode rays. Curiously enough, the cathode rays do not cross like rays of light at the focal point, but behave rather like a number of fluid jets coalescing at the focal point, and proceeding thence onwards as a solid parallel jet. The point where the rays impinge on the platinum still retains its small dimensions though the plate is placed some distance beyond the focal point.

Platinum is known to be one of the most opaque substances for the cathode rays, and thus very little of the radiation passes through the platinum foil. The greatest part of the radiation is absorbed by the platinum, and given out as X rays from the luminous point, by a kind of diffuse reflection. The anode plate, A, being set at an angle, the best part of the radiation is directed downwards through the sides of the bulb, where it can be conveniently utilised to produce the photograph in the usual way. The tube, H, through

which the bulb is exhausted, is shaped so as to permit the tube to be fixed in a stand at the required height. The anode and cathode plates are connected to the terminals of the induction coil by platinum wires fused through the glass.

The remarkably fine photograph of a lady's hand, which we reproduce, was taken by Messrs. Newton by means of a "focus" tube, fixed about 6 inches above the photographic plate. The time of exposure was about two minutes, and the tube was excited by a 2 inch spark induction coil. It does not, therefore, require a very powerful and expensive coil to excite the "focus" tube.

The photograph is of great interest from a surgical point, since a piece of a needle was known to be embedded in the palm of the hand, its exact locality being however unknown. The photograph shows the piece of needle as a short black line about ¼ inch in length lying over or under one of the bones. It can be seen, at least in the original photograph, that one end of the needle is more sharply defined than the

Fig. 2.

other. This is due to the fact that the needle is seen foreshortened, and of course, owing to the slight diffusion of the X rays with distance, the end of the needle, which is nearer to the photographic plate, is somewhat more sharply defined than the more distant end. This circumstance is important for determining the exact position of the needle. The dark patches about the wrist bones are due to the overlapping of some of the bones in the line of the rays. The varying thickness and density of the bones is so nicely rendered by the X rays, that it gives the appearance of shading, and makes the photograph look almost as if it was obtained by reflected light.

The great reduction in the length of exposure obtained by this tube will undoubtedly soon enable the X rays to be utilised for the examination of the thicker parts of the body, as, for example, in abdominal surgery. It is highly probable that, by the use of special photographic plates, and phosphorescent screens, the time of exposure may soon be still further reduced.

CORRESPONDENCE.

Concentric Cables v. Bare Strip.

Let us keep to the point in this matter, viz., the "absolute impossibility" of making a connection on a concentric cable while current is passing. Your correspondent shows signs of wandering from it.

I think low tension cables were instanced in my previous letter; but I have had connections made on concentric cables carrying current at over 2,000 volts, and though I neither advocate the practice, nor put such jobs in the hands of ordinary workmen, yet it proves that there is no "absolute impossibility" in the matter.

The job of making a connection to live concentric cables at pressures of 100 to 150 volts say, may be done in severa ways, and what is below set out for triple, applies equally to double concentric cables.

With no special fittings at hand beyond divided clamps, bare the outer wires about 2 inches more than the fittings require, and by means of a bit of insulated lead make a shunt, by binding it at each end of the bared portion. Then cut the outer, clamp the ends of the wires, and put in the usual cross-bar. The shunt may now be removed. Assume the middle wire of the main to be the neutral one, and that you want to connect the outer and neutral only. Bare enough of the middle, say 1½ inches, connect one lead of the house service to it, and the other to the cross-bar of the outer, and the job is done. This is the whole case with double cables. If now you want to get at the inner of the triple concentric, having got the outer going through its cross-bar, shunt the middle in the same way, and connect it by a cross-bar on the opposite side to the outer. All that now remains is to cut down on the inner, say 1½-inch gap, clamp one lead of the house line in it, and the other to the cross-bar of the middle wires. If you have two houses close by, you can put them both on in the same joint, one on each side.

I enclose a sketch of fittings, designed to attain the above ends without the use of the shunt. These are made to clamp the wires, and take in the cross-bars before cutting the wires. They are bared to size, and embrace 1½ inches of the wires at each end. The wires are then cut and jammed between two concentric cones. When these are on, the case is much the same as with bare strip; you have the three conductors side by side (but at different levels in the conical clamp joint), ready to have house leads clamped on. The joint is enclosed in the iron box commonly used on concentric cables. The sketch I send is not suitable for reproduction; but perhaps you will send it on to the "Writer of the Article."

J. H.

March 9th, 1896.

Information Wanted.

Can you inform me what is the highest speed any steam turbine has been known to run at? And am I wrong in my belief that you gave a description of a De Laval steam turbine that ran at the enormous speed of 60,000 revolutions per minute?

Conduit.

[The de Laval steam turbine, which we described in our issue of December 1st, 1893, ran at 30,000 revolutions. We are not sure whether this speed has been much exceeded.—Eds. Elec. Rev.]

Bangor Electric Lighting.

I agree with your correspondent, "A Contractor," about the non-return of guineas for copies of specifications as a general proposition; but in the case of the guinea set for Bangor, I really think they are cheap at the price, as containing the most curious clauses hitherto published in this line. We may hear more of this later. At present, the attitude of Bangor Corporation is that of Sancho Panza: "When anyone offers me a heifer, I always make haste

with a halter." It remains to be seen whether the engineer in this case will have any heifers to offer the Corporation to choose from.

J. H.

March 9th, 1896.

Electrical Lifts.

I have been interested in the correspondence which has been published in your recent issues on the subject of electrical lifts.

I am not surprised that the article by Mr. Gibson on the Otis lift called forth a reply from Messrs. Waygood. The impression that the article made upon me was, that the author conceived the designer of the Otis lift to have been inspired.

Now, I am quite in accord with both parties in respect to the absurdity of a combination of an ordinary motor with an ordinary winding being set up as an electrical lift. Such a lift is a power lift, incidentally happening to be driven by an electromotor.

I have, therefore, made my lift crabs in the form of a self-contained apparatus, provided with automatic gear, designed to meet all the contingencies of lift work. My experiments, however, have led me to adopt forms of control differing somewhat from those described by either Messrs. Gibson or Waygood, and the experience I have had, so far, goes to show that the devices act well.

Since my patents are not yet completed, I cannot fully describe my apparatus, but I may say that I actuate my brake by means of the magnetism of the motor, which has an ordinary drum armature—slotted—and extraordinary field magnets, which serve more than one purpose; the result being that when the current is switched *quite* off the motor the brake is applied.

Now, this touches the first point of difference between Messrs. Gibson and Waygood. For ensuring stopping at the top and the bottom of the lift well, Mr. Gibson employs the screw and nut device. Messrs. Waygood point out that they have discarded the use of the screw and nut device, and rely upon tappet switches, and by so doing they gain in simplicity, since they are able to dispense with devices for taking up the slip of the main ropes on the sheave.

Mr. Gibson comments on this omission as if it were an oversight; but what is to the point is, that he thinks that seeing that Messrs. Waygood have a brake applied by hand (like his own), they are, by dispensing with special means of stopping the lift automatically, running the risk of striking the top or bottom of the lift well.

It is true that Messrs. Waygood provide tappet switches to cut off the current both top and bottom, but this, without the brake, is not, in Mr. Gibson's opinion, enough.

It appears to me chiefly a question of the amount of clearance between the car and the end of the lift well after the tappet switch has been struck; but, in any case, my own plan should meet with Mr. Gibson's approval, since the moment the tappet switches are opened (I use tappet switches) the brake is applied. I am, therefore, able to do without a screw and nut device, or any equivalent, and also get out of the difficulty of having to supply any devices for taking up slack.

The next point referred to by Mr. Gibson is the solenoidal device used in the Otis crab for automatically regulating the current strength. It is no doubt very necessary that the strength of the current should be regulated independently, and should not be under the sole control of the attendant. At the same time we want simplicity, and I do not see the necessity for the special solenoid which, I understand, is provided in the Otis device. I control my switch by the twisting moment set up in the motor's armature by the current; this varies with the current supplied, and so gives me exactly what I want, but does away with the complication and the cost of providing the special solenoid. It is only fair to say that the principle is exactly the same as that of the Otis.

Finally, as to bearings, I certainly agree with Messrs. Waygood that ball bearings are excellent for taking up the thrust for light work (such as most lift work is).

If the Otis designer preferred to use plain bearings supported on levers, so arranged that the pressure is equally distributed, well and good; but for *light work*, ball thrust bearings work so well that it is needless to go further afield. For heavy work, I should certainly prefer—and should provide—something of the character that Mr. Gibson refers to.

J. G. Statter.

March 10th, 1896.

P.S.—Mr. Gibson over-estimates the heating effect of a rush of current when stating that an armature costing £50 to repair might be burnt out in a *few seconds*. The fuses would act quite quickly enough to prevent damage of this nature.

In your last week's issue you published a letter from Mr. W. A. Gibson, of the Otis Elevator Company, in which, after wisely stating that anything of a controversial nature would not be either desirable or proper in your columns, he proceeds to give a criticism upon the construction of our electric lifts, with the object of suggesting that they are not reliable, and that no one could make a satisfactory lift except his company.

We venture to think that anyone else than Mr. Gibson would consider such statements decidedly controversial, and while we have no wish to follow his example and in any way to attack his article or the machines produced by his company, there are one or two statements in his last letter which are calculated to produce entirely erroneous impressions, which we must ask you, therefore, to allow us to rectify.

With reference to Mr. Gibson's assumption that any machine resembling in general design those of the Otis Company is therefore necessarily an imitation, we can only say that our design is the natural development of worm and wheel lifting gears, which have been made by us and other engineers for many years, and which we have now adapted for driving direct from electric motors.

A more serious point is the danger suggested of burning out the armature if the starting rope should fail; but this has naturally been foreseen and provided against, so that in our machine also, an excess of current brings its own remedy, and prevents any injury to the motor.

Mr. Gibson seems to be under the impression that the tappet switches operated by the cage and balance weight are used for automatically stopping the lift at top and bottom of travel *during ordinary working*; but this is not the case, as would be seen by reference to our letter. For this purpose we use stops on the hand rope, exactly as in hydraulic lifts, which arrest the cage gradually in case of inattention on the part of the person working the lift, and consequently the tappet switches would only come into action if the starting rope fails to act.

The screw and nut cut-off arrangement has been used for many years for power lifts, and has many advantages; but we consider the employment of an entirely independent method of stopping the motor, which would operate if the main switch, from any cause, was jammed or locked, a decided addition to the safety of the lift.

Mr. Gibson, no doubt owing to pressure of business, has evidently read our letter very hurriedly, or he would not have made the mistake of stating that we use no "grooved winding drum."

Our statement was that "we are enabled to use a grip sheave instead of grooved hauling drum *in such situations where a hauling drum would involve grave difficulties*." As a fact, we use grooved drums in the majority of our lifts, and in this type provide a special safety device to cut off the current if the ropes become slack, by acting on an independent switch. Our controlling arrangements give us the advantage of being able, by using a grip sheave, to use electric lifts in situations where, if we were bound by the screw and nut arrangement to the use of a drum, it would not be possible to use this kind of lift at all.

We do not find any necessity for any special arrangement for taking up slip of rope with a grip sheave, as we do not find it occurs in ordinary working, and if it did happen, it would not disarrange our safety devices. Our safety gear for preventing the fall of the cage if the ropes break is in

operation on far too many lifts to need any defence or explanation.

With regard to the ball bearings, we are satisfied for the present to know that we get 65 per cent. to 70 per cent. efficiency with our gears, which we believe to be equal to general engineering practice at the present date.

We quite agree with Mr. Gibson that intending purchasers and their engineers should examine the different systems for themselves, and are glad to know that our lifts have been examined in comparison with the Otis lifts by electrical engineers, whose competence Mr. Gibson would not question, with results satisfactory to us; and even if, from our native modesty, we cannot successfully compete with Mr. Gibson in the ability to advertise our productions, we do not fear any unprejudiced examination of our work, as we are quite at one with Mr. Gibson in endeavouring to encourage the use of electric power for lifting purposes, and also to encourage the manufacture of machinery of the best design and construction only for use in connection therewith.

Per **R. Waygood & Co., Limited,**
D. W. R. Green, *Secretary.*

Concentric Wiring.

Under a five-minute time limit, and owing to a certain red herring which cropped up during the recent discussion at the Institution, I was debarred from adding a few words in favour of an old love of mine, viz., concentric wiring. I think I may not unfairly claim to have taken a somewhat prominent part, in the early stages of its existence, not only in advocating its use, but in defending it against the opposition it had to contend with—for I am sorry to say it met with a good deal of opposition in those days, and that from a quarter whence it should never have come. I recognised that it would give us all the electrical, and at the same time, all the mechanical, protection we could desire, and that to a higher degree than was attainable by any other system then in vogue; and in advocating its use, I was in reality promoting the interests of the fire offices. Unfortunately, my humble efforts were not appreciated. It was urged, for instance, that it involved a bare return—a horrible thing. And that that necessitated earthing—a still more horrible thing, for there was confusion between an earth return and an earthed return. But more than all—and here was the rub—it did not conform with our much beloved rules, and therefore could not be allowed. Well, needless to say, common sense prevailed in the end, as it always will; concentric wiring was admitted among the good things, and allowed with certain necessary restrictions, those restrictions being due to the fact that you must not mix it with other and weaker systems without certain precautions being taken. No, the concentric is so strong and robust; it revels in an earth, whereas its weaker brother cannot stand the racket of one, and if you put the two side by side, it will be a case of the lamb and the lion; you will very soon have the lamb inside the lion. But the weaker being in possession, the stronger, for once has to go to the wall. This doubtless is the reason why concentric wiring has comparatively made so little headway. But where you stand untrammelled by weaker neighbours; where appearances are of secondary consideration; but, where safety to life and property is paramount, then there is no system I know of that will give you that safety to the same high degree as a well carried out concentric. Surely if we are coming to much higher voltages in our lamps—which seems to be the order of the day—earthing will in due time follow as a matter of necessity, and when it does come let me say concentric wiring will then assert itself in a manner not to be denied. It is true it has recently been pointed out that in spite of earthing it will nevertheless be possible for a person, under a whole cargo of "ifs," and when performing a certain gymnastic feat, to receive the difference of potential between the outers of a three-wire system. No doubt that is so, many things are possible. But allow me to add, with concentric wiring that little gymnastic performance would not avail. Not long since I had the pleasure of meeting with one of those rare instances where an engineer had the courage of his convictions, and had earthed the centre of an extensive three-wire system. I refer to the new Free Port of Copenhagen, where everything is done by electricity that can be. There "earthing" had been effected by simply allowing the third wire (a bare conductor) to lie in contact its whole length underground with the iron tube containing it. This answered perfectly, gave no trouble, they knew nothing about electrolysis, and the engineer in charge assured me that after an experience with an earthed three-wire system, he would be sorry to go back to an unearthed one. I could not at the time help thinking what an opportunity this would have been for concentric wiring. Unfortunately in Denmark, as, indeed, also throughout Germany, one meets with little else than that frail system of wiring, whereby the conductors are strung upon insulators and wholly exposed. Electrically, it is very good undoubtedly; but mechanically it is weak, and I have seen numerous instances where the conductors, in workshops and factories, had received serious injury. In Germany they have long since discarded wood casing. They say it is bad. Well, while disposed to agree, I cannot help thinking our German friends have gone too far in the other extreme by neglecting to protect their conductors from mechanical injury.

Failing the concentric, I would pin my faith upon a well carried out tube system, and by a tube I mean that which is both fire and nail proof, with every facility for in-drawing and withdrawing conductors. Mechanically, it is undeniably strong; electrically, it may be slightly weak, but there is the consolation in knowing that if the electrical arrangements fail, the mechanical will be equal to the strain, and no harm will ensue. But where allowed a choice, I would still give it in favour of my old love, the concentric.

H. Human.

6, Prince's Street, E.C.

The Wiring Question.

In a former letter on the above question, I mentioned that "I am not by any means a strong advocate of trades union principles as carried out in this country," and I may say that at the time I made use of that expression, the organisation foremost in my mind was, "The Electrical Trades Union," and my opinion is strengthened, rather than weakened, after reading the letters of members of the E.T.U. in your issue of February 28th. Take, for instance, the letter signed "A. Calipé." I fail to see how the interests of any society can be furthered, when the weapons used in putting forth its claims are composed so largely of abuse as "A. Calipé's" evidently are, and it cannot be called honourable to assume that because one man differs with another on any point, that either one or the other is incompetent, untrustworthy, dishonest, or drunken.

I am not acquainted with your correspondent "Mac," or his friend, but I am not surprised that either of them should have qualms as to joining a society having no better advocates than the one mentioned above.

I have no doubt that all that has been said in favour of the Electrical Trades Union is true as regards London, and, perhaps, one or two other places, but it must be taken into consideration that there *are* other places, and that a map of London does not take in the whole of the British Isles, and although the London branches of the E.T.U. may be carried on in accordance with rules, and on business principles, the same cannot be said of some of their provincial branches.

I have in my mind one branch in particular where out of about 40 members, ten (10) were what might be considered competent, practical men, the remaining 30 being composed of labourers and hangers on, all claiming equal benefits; at least, they would have claimed equal benefits had there ever been any to claim, but, as a matter of fact, after the first year's subscriptions had been paid, and claim on benefits became due, the branch was coolly asked to withhold its claims for another year, the reason given being that the executive committee were short of funds. This, coming as it did after the London office had sucked the blood of the branch for 12 months by taking all the money it could lay hands on, caused most of the members to discontinue its payments, and I was one of them.

The above has been, from what I have heard, not by any means an uncommon experience with branches of the Electrical Trades Union. Therefore it is not to be wondered at that there is a general call for a reformation in the conduct of a society for *bonâ fide* men, and I may here mention that since I last wrote you on the subject, an endeavour to form

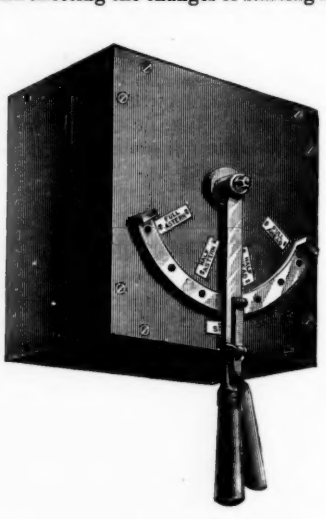
a combination of all persons interested in electrical engineering has been brought to my notice, and I am led to understand that in the course of a few days the aims and objects of the organisation will be made generally known, and I am permitted to state that, *pro tem.*, any communication with regard to the same will be attended to by Mr. Frank H. Butler, of 23, Burnell Road, Owlerton, Yorks, who has consented to act as honorary secretary, and who, I do not doubt, will be glad to hear from your correspondent "Mac," and any other person anxious to further the interests of the electrical trade.

Thanking you for the prominence you gave to my last letter, and apologising for again presuming on your space.

Floreat Electra.

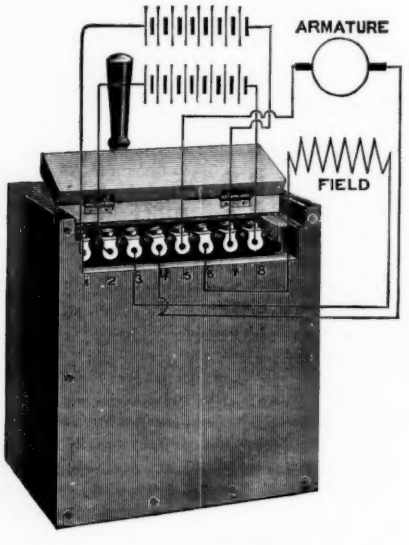
A Battery Switch.

I do not know if it would interest your readers, but I enclose two photos of an improved launch, tramcar, and vehicle switch with a single lever, having only one radial movement, and effecting the changes of starting and stopping.



reversing, and putting cells in series and parallel. All the changes are automatically made before the circuit is closed. The connections from contacts are conveniently brought out

BATTERY.



to a row of terminals. On removing the handle and cover, the switch complete may be withdrawn from the box, which latter is made watertight. I also enclose a diagram showing how easy it is to connect up to motor and battery. The illustration is of a 30-ampere type, and measures 10 inches × 10 inches × 8 inches. The contacts are few in number (about 10), and all sliding type; there is no "barrel."

Walter A. Clatworthy.
(*Patent No.* 2,228.)

February 26th, 1896.

The Paper Making Machine as a Generator.

You are perhaps aware that there is a large amount of electricity generated in paper making machines by the passage of the sheet of paper between the drying cylinders and calendering rolls; this is found to be very detrimental to the paper when used for printing purposes.

A decided shock can be felt on passing in front of the rolls at a distance of 3 or 4 feet from it, and a gas jet has been lighted by the current passing through a person's body. Can any of your readers suggest any means for extracting this electricity from the paper?

Henry Rogers.

Watford, *March 3rd*, 1896.

[This can be effected by the well-known device of connecting the metal rollers, over which the paper passes, to earth by means of a wire connected to, say, a water pipe.—Eds. Elec. Rev.]

LEGAL.

FOWLER *v.* THE CHELSEA ELECTRICITY SUPPLY COMPANY, LIMITED, AND SANDON *v.* SAME.

In the Chancery Division of the High Court of Justice, on Friday, the 6th inst., this matter again came before Mr. Justice North. It will be remembered that on December 6th last Mr. Warmington, Q.C., on behalf of the plaintiff, Mr. Sandon, a leaseholder of a large block of buildings let out as residential flats in Cadogan Gardens, Chelsea, moved for a sequestration order for disobedience of an order or injunction made on the 25th June, by consent, restraining the defendants from so working their engines and carrying on their works as by noise and vibration to interfere with the enjoyment of the flats of the plaintiffs. The contention of the defendants, then, was that they had done all they could in the time to remove the nuisance, and in the result Mr. Justice North thought the defendants should be allowed further time to complete their improvements, and accordingly he extended the time for three months.

Mr. VERNON SMITH now said he had a motion on behalf of the defendants in both actions to extend the time of suspension for a further period.

Mr. WARMINGTON said he wanted to know whether the evidence on behalf of the defendants was closed.

Mr. VERNON SMITH said he was not in a position to say that it was, and that the motion was not ripe for hearing.

His LORDSHIP said that Mr. Smith had a right to save his motion.

Mr. WARMINGTON: On behalf of Mr. Sandon we have asked for an inspection of the defendants' premises. We have been met in such a way that we are not able to get an inspection by electrical experts.

His LORDSHIP: Did I not give the plaintiffs some option to have some inspection?

Mr. WARMINGTON: Yes, my lord, and we are entitled, under your lordship's order, to inspect with an expert, but they claim the right to object, and that the matter should come before your lordship to say whether the person whom we desire should inspect is a proper person, or whether their objection is a good one. We got so far as this—we named a Mr. Harrison; we took out a summons; they objected to him; and that has been before the Chief Clerk. They give no definite objection; all they say is, "We think he is not a fit and proper person."

Mr. SMITH: We say that he is connected with a rival company, and that it is undesirable that he should be appointed.

His LORDSHIP: I don't think this is a matter that ought to go before the chief clerk.

Mr. WARMINGTON: Will your Lordship allow it to come before you on Monday?

Mr. SMITH said he did not object to this course.

His LORDSHIP said he thought he had given the plaintiffs the option to have some inspection by experts, and that if there was any difficulty, he should appoint some person himself.

Mr. SMITH said the terms of the order were that the plaintiffs were at liberty to inspect, by persons agreed upon by the plaintiffs and defendants, and in case of difference, by some person appointed by the judge. The defendants had suggested six persons—all persons of eminence—to all of whom the plaintiffs objected. The defendants were now perfectly willing that any independent person whom his Lordship should name should go and inspect the premises.

His LORDSHIP said he really did not appreciate the difficulty, as there must be plenty of persons competent in London to whom no objection could be made.

Mr. SMITH said that Mr. Birstall had already been on behalf of the plaintiffs, and he might go again.

Mr. WARMINGTON: Mr. Birstall is a surveyor; we want an electrical expert to go there. If the matter was before your Lordship for a

quarter of an hour; if a particular name was objected to, we could name another, and then we could get an order. As long as it is like this—that every person we name is objected to, it will be weeks before we can get a person. Mr. Warmington said that in the judgment the plaintiffs and defendants were at liberty to inspect each other's premises, and any number of persons from the defendants had inspected the plaintiffs' premises. The plaintiffs had allowed any person from the defendants to inspect their premises at any time.

After some further discussion it was agreed that the plaintiffs should furnish a list of three or four persons, and the defendants would state their objections, if any, to one or other of the persons, the case to be in his Lordship's paper for Monday for the appointment of a person, should there be an objection to the persons named by the plaintiffs.

Clark *v.* Julius Sax & Co.

In the Chancery Division of the High Court of Justice on Friday, the 6th inst., Mr. Swinfen Eady, Q.C., stated before Mr. Justice North that he had a motion on behalf of the plaintiff to restrain the infringement of a registered design for an electric lamp of a particular shape. It was in respect of the same design as was before the Court in February. On that occasion he moved for an injunction to restrain the infringement of the registered design, and there was a cross motion to take the design off the register. His Lordship then refused both motions, and the result was that the registration of plaintiff's design was upheld, and it was held that the defendants had not infringed plaintiff's registered design. Now, what the defendants had done was to exactly copy plaintiff's design.

Mr. Vernon Smith, on behalf of the defendants, interposing, said he disputed that. He asked that the motion might stand over until next motion day. On Tuesday he received copies of the plaintiff's affidavits, and it was desirable that he should get affidavits of experts to answer them. His case was that there were substantial differences between the defendants' lamp and the plaintiff's.

Mr. Justice North gave directions about the delivery of affidavits, and directed the motion to stand over for a week.

Metropolitan Electric Supply Company *v.* House and Land Investment Trust, Limited.

In the Chancery Division of the High Court of Justice, on Monday, the 9th inst., Mr. Justice Romer had before him in this case a Court summons on behalf of the Metropolitan Electric Supply Company, raising the question how the House and Land Investment Company was to pay them for electric lighting.

Mr. Buckley, Q.C., stated that the House and Land Investment Trust were the holders of property called Whitehall Court, on the Embankment, and the applicants supplied them with electric light, &c. The question for the Court was what was the effect of a contract dated April 19th, 1888. The House and Land Investment Trust was in liquidation, and all the electric light in question had been supplied since the liquidation. In April, 1888, the Whitehall Electric Supply Company, who were the predecessors in title of the Metropolitan Company (who were the present applicants), entered into an agreement with the House and Land Investment Trust for the supply of electricity to their premises "at a cost or charge per light not exceeding the lowest price at which the company shall from time to time, or at any time during the term of the lease (which was for 90¾ years) supply light by electricity to any other person or persons, company or companies." The claim of the applicants was for £3,630 5s. 8d. for electricity supplied under the agreement. The electricity company generally supplied their electricity by meter, but they also had contracts for lump sums, though in some of these cases they had used a meter merely for the purpose of ascertaining how much electricity was supplied. The question was what was the lowest charge the company made per unit, and he submitted that for this purpose the lump sum contracts were not relevant.

Mr. Bramwell Davis, on behalf of the liquidator, submitted that the question was what was the lowest price per Board of Trade unit that any person had been charged during the period in question?

Mr. Justice Romer: When they are charged per unit.

Mr. Bramwell Davis contended that the basis on which payment should be made was the lowest charge per unit, with excepting the lump sum contracts.

Mr. Justice Romer said he did not think the respondents ought to take advantage of an accidental speculation on an entirely different system, and complained of the bad draughtsmanship of the agreement as bringing about the dispute.

Mr. Bramwell Davis: Some of us would have bad times if these things did not come to be considered by the Courts.

Mr. Justice Romer, in giving judgment, said that under clause 7 the provision was that the Trusts were to be supplied with electricity at a cost or charge per light not exceeding the lowest price at which the company supplied others. As a matter of fact, very little electricity was supplied at a cost per light by the electric company; therefore it was agreed between the parties that they could not carry out this contract according to its strict letter. What they had been doing was this. Their general system was to supply electricity at per unit of energy, and they also, in exceptional circumstances and by special agreement, had with different individuals agreed to supply electricity at a lump sum per year. Under the circumstances it appeared to him the fair position of affairs was this. If the Trust Company was being supplied per unit, then he ought to look round and see what the electrical company was supplying other persons at per unit. As between these parties the arrangement was to supply electricity per unit, he decided that the lowest rate per unit at which the electricity company was supplying others with electricity was the basis on which the applicants should be paid.

A further question was then raised as to how the accounts should be rendered and paid.

Mr. Justice Romer thought that accounts ought to be rendered and paid quarterly, and that the charge should be the lowest price which the company charged in the previous quarter. In his opinion that ought to apply to the past and the future.

Judgment was accordingly given in favour of the applicants, the figures being left to be marked out, and the liquidator's costs were ordered to come out of the estate.

The Coventry Electrical Engineering Company.

This was a mortgagee's action, and it came before Mr. Justice North in the Chancery Division on 10th inst, upon a motion for the appointment of a receiver and manager of the assets of the defendant company. Mr. Whinney, who appeared in support of the motion, stated that the reason for it was that actions had been commenced against the company which would be heard that day. The company had no defence, and judgment would accordingly be obtained against it. Mr. Justice North appointed Mr. Pearson receiver and manager, with liberty to act at once, and added that, if the company consented to a final decree upon the present motion, the order might be so drawn up.

BUSINESS NOTICES, &c.

"Architecture."—In monthly illustrated journalism there are few productions published in London which excel the second number of *Architecture* (March). There is an excellent forward movement in newspaper and magazine production in these days, and the growing desire on the part of publishers of either new or old journals seems to be the cleaner printing of improved process blocks, and to this end the use of better qualities of paper. The publishers of *Architecture* have undoubtedly aimed high and have succeeded in issuing a very creditable magazine, which, notwithstanding the extent to which the world of art and architecture is at present catered for by other journals, we believe has a good future in store if the very high standard of the March issue is continued. The interest of the articles is great, and is materially added to by tasty little sketches of cosy nooks and corners in some celebrated abbeys and cathedrals, and other places at home and abroad, where choice renaissance abounds. In fact, as one ponders over the achievements in church architecture, enhanced by the softening effects of time and nature, fresh impressions of the sacred influence and the magnitude of the world of art present themselves. The electrical engineer, as he lingers over these sketches, will—unless he be entirely devoid of sentiment—be, for a while, lifted out of his matter of fact life of hurry and bustle into the quiet of memory and contemplation. The magazine is well worth obtaining.

Averaging Instrument.—Messrs. Jackson Brothers, Limited, of Leeds, have sent us a list of Goodman's patent averaging instrument for rapidly obtaining the mean height of indicator diagrams, &c.; also of Goodman's patent planimeter for measuring areas.

Bankruptcy Proceedings.—In the Oldham Court on January 23rd, suspending for six months the discharge of Dr. Joseph Whatmough, trading at Oldham as D. J. Whatmough, J. & P. Dyer, and W. Mason, as hosier, tailor, draper, electrical engineer and fitter.

At the Brentford County Court on Friday last, before His Honour Judge Bagshawe, the application of Mr. Ronald A. Scott, to be discharged from bankruptcy, came on for hearing. Mr. Cecil Mercer said the application ought to be adjourned until the examination of "Ronald A. Scott, Limited," had been concluded. The bankruptcy of Mr. Scott was intimately connected with the company. His Honour: I quite understand that. Mr. Mercer: It is a very important matter. His Honour: You are quite entitled to have time for consideration. Mr. Scott said he would not object to the adjournment. The application was accordingly adjourned till April 17th.

The failure has been announced at the London Bankruptcy Court of Walter Northcote, inventor and electrician, late of 481, New Cross Road, trading as W. Northcote & Co. The debtor states that all his plant was destroyed by fire last November. He received £280 from the insurance company, and paid it away to his creditors. The amount of the present liabilities did not transpire.

Business Announcement.—Messrs. John Hall & Son, ironfounders and machinists, of Oldham, have recently erected plant for the manufacture of small malleable and cast steel castings at Union Ironworks, and have engaged the services of Mr. R. W. Todd, to take the management of this branch.

Committed for Trial.—A man named Peter Bradley, recently in the employ of Messrs. Sharp & Kent, at Blackpool, was committed for trial on Thursday, last week, on a charge of embezzling certain sums of money belonging to that firm.

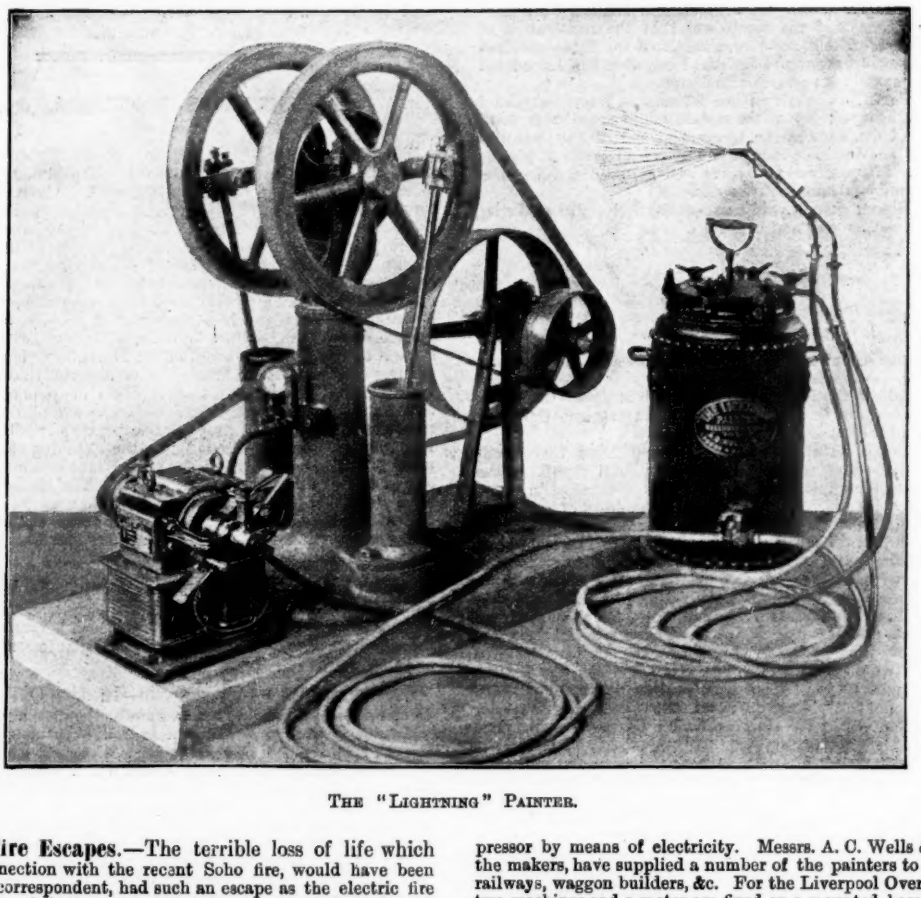
Double Push Switch (Dingle & Urquhart's Patent).—Upon the possession of a thoroughly reliable switch the efficient working of electrical installations greatly depends, and practical electricians are always ready to welcome a novelty that has for its object the perfecting of domestic and general lighting switches. Amongst the varied

branches of electricity, none have called for the exercise of more ingenuity than the improvement of switches, and this double push switch is the outcome of many years experience of the inconveniences and defects of ordinary switches. It is claimed to be a positive remedy for these defects, and its inventors offer the following facts to practical electricians as being sufficient to base an opinion as to the merits of the double push switch. The twisting, pulling, or lever-raising, or lowering action of other switches is avoided and superseded by the more natural readily understood and simple method of pressing in a push button or plunger. When the "make" push button or plunger is pressed in flush with the surface plate of cover, the contact is formed and the switch automatically and positively locked, and is proof against every possible vibration or force, except direct and intentional pressure upon the "break" plunger. The contact is the best possible, a self-cleaning, rubbing, spring contact. No half contact is possible at any time; it must be full contact, and, therefore, locked, or else perfectly, instantly, and entirely broken, when pressing on the "break" plunger, thus unlocking the switch and allowing the contact lever to fly up away from contact independently of and free from the rest of the mechanism. The switch is mounted on best English porcelain and all the brass parts are substantial, well made, and finished. Messrs. A. Vandam & Co. are introducing this switch.

governing is perfect; it is most economical in steam and oil: it has Corliss valves and automatic expansion; it has short ports and small clearance; it has immense wearing surfaces; it is applicable to every purpose; it can be repaired by any mechanical engineer.

Trade in the Far East.—Under the title of "Future Trade in the Far East," Messrs. Whittaker have in the press, for production early in the current month, a useful contribution to the literature of the Far East. The work, which is by C. C. Wakefield, F.R.G.S., a member of the London Chamber of Commerce, who has had special opportunities for obtaining information from personal observation in the countries covered, will deal solely with commercial matters, is fully illustrated, and will contain a new and important map showing the latest developments in the trade routes—particular attention being given to the Trans-Siberian Railway now in progress.

The "Lightning" Painter.—We illustrate below the "Lightning" painter, as supplied to the Liverpool Overhead Railway Company, at Liverpool, to work with an electric motor. The machines, which are made under the Wallwork and Wells's patents, are intended for spraying paint by means of compressed air, and by this method it is claimed that many difficulties are overcome. The chief point of interest to electrical men is the driving of the compressor by means of electricity. Messrs. A. C. Wells & Co., who are the makers, have supplied a number of the painters to boiler makers, railways, waggon builders, &c. For the Liverpool Overhead Railway two machines and a motor are fixed on a mounted base covered in so that it is easily portable.



The "Lightning" Painter.

Electric Fire Escapes.—The terrible loss of life which occurred in connection with the recant Soho fire, would have been averted, says a correspondent, had such an escape as the electric fire escape been in use, it being a permanent fixture of tested steel cable wire with steel rungs, having connections from the ladder to a system of electric bells with a fire indicator, which, when at a certain heat, will cause the bells to ring and thus arouse the inmates.

Ganz & Co.—Messrs. Ganz & Co., of Budapest, have just issued their report for the past year. It shows a net profit of 700,353 fl., which will admit of a dividend of 25 per cent. The directors have given up the idea of converting their extensive electrical engineering department into a separate concern, and are making arrangements for extending this portion of their works.

Pole Finder.—From Mr. A. H. Avery, of Tenterden, Kent, we have received a specimen of pole finder paper as made by him.

Price List.—Messrs. W. Gorse & Son, of Birmingham, have sent us a new reduced illustrated price list of a variety of kinds of tacks, nails, pins, rivets, hooks, electric and other staples, &c., &c.

Raworth's High Speed Engine.—We have received a pamphlet containing a description of the Universal high speed steam engine (Raworth's patent) for which the following advantages are claimed: The working parts are enclosed, but are readily accessible; all wearing joints can be set up in a few minutes without filing or fitting; the system of lubrication is automatic throughout; the

ELECTRIC LIGHTING NOTES.

Aberdeen.—We learn that in view of the increased demand for the supply of electric current, it has been remitted to the electrical engineer to report as to an extension of the works and mains. In the meantime tenders are being invited for an additional engine for the electric lighting station of 300 horse-power.

Aston.—Mr. Vaudrey recently reported on the question of the simplest method of putting in order and working the electric light at the Baths, Free Library, and Council House. The plant is to be duplicated, an additional engine and dynamo being put in position at an estimated cost of £350.

Ayr.—Mr. Hammond recently explained to the Committee that the testing of the transformers had disclosed that they were one-third below the specified dimensions, and the meeting requested him to give a written report anent them with the view to intimating a claim against Messrs. Swinburne

for the whole extra expenditure which their failure entailed. Mr. Hammond recommended that seven transformers should be purchased as against those which Messrs. Swinburne had failed to supply, and in view of the urgency of the matter, the committee approved. It was agreed to discuss this matter in private.

At a Town Council meeting, held on 9th inst., a long report was submitted by Mr. Hammond, the electrical engineer, in which it was stated that, with the exception of the transformers, the plant was in good order. With reference to the transformers which had proved defective, he pointed out that in terms of the conditions of the contract, the Corporation were entitled to reject them. It appeared that new contracts for efficient transformers had been entered into with Messrs. John Fowler & Co. It was agreed, on the motion of Mr. Grant, that Mr. Hammond should be requested to furnish a supplementary report with regard to the temperature test of the defective transformers at the works of the contractors before delivery. It was intimated that Messrs. Callender & Co. had expressed their willingness to guarantee their cables for five years, and the Council agreed to accept the guarantee. It was agreed to apply to the Secretary for Scotland for power to borrow a further sum of £5,000 for the electric light.

Belfast.—A report just prepared by two members of the Corporation regarding the police cells includes, among other recommendations, a proposal to light the cells by electricity, a wire-guarded lamp being used.

Brighton.—Electric lighting mains are to be extended down Edburton Road, and four 10-C.P. incandescent lamps erected there; 15 arc lamps are to be erected in Upper Street, James's Street, St. George's Road, and Chesham Road; and 15 arc lamps in Lewes Road and Richmond Terrace. The Town Clerk is to appeal against the assessment of the electricity works. The electric lighting accounts for the year ended December 31st, 1895, have been submitted, the revenue account showing a total expenditure of £9,561 0s. 8d., the chief item being coals and other fuel, &c., £2,595; oil, waste, water, and engine room stores, £531 14s. 5d.; wages at generating station, £1,719 4s. 11d.; repairs and maintenance, £435 5s. 4d.; distribution expenses, £1,473 0s. 5d.; public lamps, £569 15s. 1d.; rents and taxes, £327 0s. 11d.; management expenses, £1,838 0s. 9d.; and special charges, £70 8s. 1d. The revenue was £18,575 3s. 8d., comprising a balance of £1 10s. 3d. from last year, £16,177 2s. 4d. derived from sales of electricity, £1,429 19s. 11d. from public lamps, and £966 1s. 2d. from meter rents and sundries. A gross profit of £8,927 5s. 11d. was carried forward to the net revenue account, leaving a balance of £86 17s. 1d. to provide for bad debts. The net revenue account showed that £1,404 1s. 9d. had been applied to local rates, and £3,000 paid to reserve fund, and that after payment of interest and sinking fund appropriations, a balance of £1,150 was carried to next account; £2,000 has been transferred from the electricity works account to the district fund account. The average number of units sold was 7½ per inhabitant. There are connected to the mains, 53,000 lamps, and 600 more have been applied for.

Burton-on-Trent.—The Borough Accountant has furnished the following particulars with regard to the electric light:—The expenditure on capital account for buildings, machinery, mains, &c., during the year has been £1,626 5s. 8d., which, with the amount previously expended, viz., £27,008 6s. 4d., made a total capital outlay of £28,634 12s. This sum includes the expenditure on the Ashby Road mains, amounting to £1,159 2s. 4d. The amount of stock issued to that date was only £25,992 17s., so that the capital account was overdrawn to the extent of £2,641 15s.; during the present month, however, the new loan of £5,000 has been issued, leaving a balance now in hand of £2,358 5s. for future requirements. The revenue account shows a total receipt of £1,050 14s. 3d., against £506 18s. 5d. the previous 10 months, the working expenses being £1,342 14s. 8d., against £843 18s. 10d., showing a loss of £292 0s. 5d., as against £337 0s. 5d. The amount provided for dividends on stock, and contribution to redemption fund, was £1,487 4s. 4d., the same as the previous year. Three per cent. stock, to the value of £707 8s. 8d., has been cancelled, leaving the amount now outstanding at £25,285 8s. 4d., but against this the sum of £741 0s. 9d. is standing to the credit of the redemption fund account, of which £728 15s. 5d. is invested at 3⅜ and 3¼ per cent., and the balance of £12 5s. 4d. is in the hands of the treasurer. The total sum to be transferred from the general district rate is £1,779 4s. 9d., against £1,802 9s. 3d. last year, the estimated amount being £1,860. The number of consumers at December 31st, 1895, was 64, against 52 the previous year. Alderman Lowe regretted that there were not more users of the electric light, and stated that until there were, they could not expect to make any profit out of it.

Bristol.—We understand that the provisional order for electrically lighting the Bristol suburbs is not to be proceeded with.

Colchester.—The officer commanding the Royal Engineers (Eastern District) has written to the Town Council stating that the War Department would be prepared to take the electric light for the block of officers' quarters, the officers' mess, and the recreation buildings in the new barracks, if the current could be supplied satisfactorily. As to the general lighting of the barracks by electricity, the result of experiments being tried elsewhere must be awaited.

Colliery Lighting.—The Sheffield Electric Light and Power Company are fitting up the Langwith Colliery with the electric light. A powerful dynamo has been put down, capable of lighting up the whole of the premises, both on the surface and underground. The lights vary from 50 to 16 C.P., and about 100 lights are in use. The fittings are all watertight and dust proof.

Chesterton.—The Chesterton District Council recently wrote to the Cambridge Electric Supply Company asking whether they could light their district by electricity. The Company, after going into the matter, has replied that their powers do not include the Chesterton district.

Cheltenham.—£15,000 is to be borrowed for electric lighting extensions to be ready for next winter. In moving a resolution to this effect at the last Council meeting, Alderman Norman said everywhere the experience was that, liberally treated, the electric light was financially successful, and Cheltenham was no exception to the rule. During last quarter the receipts were something like £420, and the expenses at the station about £370, so that they had made an actual profit of about £45 to be applied towards the payment of interest, &c.; and they might look upon the second year as a year paying its own expenses. Having pointed out that, in lieu of the unit of 100 kilowatts hitherto adopted at the station, it was proposed to adopt a 200-kilowatt standard, which the engineer recommended as more economical and efficient, Alderman Norman said he need hardly amplify other details given in the report. He laid before the Council a plan showing the proposed extensions of mains, explaining that these would be carried out subject to any emergency which might arise, but, at any rate, they would form part of the general scheme for the lighting of the town. A schedule had been prepared of the thoroughfares in which it was proposed to make extensions, but these were details which might be left for the present to the engineer and the Committee; seeing that every single extension was brought before the Council prior to being finally approved. It only remained to notice Major Cardew's report upon the lamentable accident which recently took place. He (the speaker) had little to say on that subject; and but for one sentence in the report, he should have had no remark at all to offer. He thought that that one sentence was a little strained, and that if they had had an opportunity of appealing to the Inspector, and reminding him of one or two facts before the report was made public, that sentence might have been eliminated. So far as the facts were concerned, the electrical engineer had made his comment upon them, but so far as the general tendency of the report went, the Committee had loyally bowed to Major Cardew's recommendations, and every one of the recommendations had been carried out. As chairman of the Committee, he had some responsibility in the matter, and he regretted that these recommendations were not made in anticipation at the time of the construction of the works, when all the plans and estimates were laid before the Board of Trade and the Local Government Board for approval. None of these recommendations were contained in the regulations issued only within the past fortnight by the Board of Trade, all of whose rules and regulations had from the beginning been observed, and had formed part of the machinery of the Cheltenham electric lighting supply.

Dundee.—The electricity accounts collected for the nine months ending January 31st last were £2,764 12s. 6d., and that collected in February amounted to £339 15s. 11d., making a total of £3,104 8s. 5d. Contrasted with the same period in the previous year, this shows an increase of £745 1s. The gas consumption has increased enormously.

Eastbourne.—At the last Council meeting, Councillor J. C. Wright said he would like to ask a question with regard to the cost of electric lighting. He found that the cost of a quarter's supply and new fittings, &c., came to £120, and that meant £400 a year. He also found further down that in regard to the lighting of the front £174 was put down, and that meant £600. Putting these two items together it came to at least £1,000 a year. His question was what price was paid per unit to the Electric Lighting Company.—Alderman Pocock: I can't answer it in every point. I believe it is 8d. per unit, but as far as the front is concerned, I believe it is served under a contract.

Edinburgh.—There were 70 applications for the post of resident electrical engineer, these being reduced to a list of six, including two members of the present staff. These six are to be interviewed by the Convener. The Electric Light Committee has decided to recommend the Council to ask Prof. Kennedy to become a permanent official of the Corporation, and, as chief engineer, to advise upon all points in connection with the installation.

The Council has decided that no action be taken at present on a letter from Messrs. Walter Dixon & Co., Glasgow, on the subject of electric traction for tramways.

Fareham.—The District Council has received a letter from the Board of Trade to the effect that they were prepared to sanction the transfer of the electric works from the company to the Council, provided an undertaking was given that the wires for the street lighting should be placed underground within three months. A long and angry discussion ensued when a letter from Mr. Manville, electrical engineer, was read, stating that he was prepared to give advice and to superintend the transfer at the usual charge of 5 per cent. on the contract, with a minimum fee of 75 guineas. This was at last agreed to by three votes to two, the dissentients thinking 20 guineas would be sufficient for the advice which they needed as to the laying of the cables only.

We learn that it has been definitely decided that the management of the electric lighting works shall be taken over from the company by the urban council from the 16th inst.

Grimsby.—The Public Lighting Committee has appointed a sub-committee to obtain information *re* electric lighting, and report. The two years specified under the 1894 provisional order expires on July 3rd.

Goole.—We understand that the Aire and Calder Navigation Company have decided to illuminate their docks at Goole by electricity. Hitherto, the dock premises have been lighted by gas from the local works.

Gateshead.—This town's Corporation would appear to be completely out of touch with the events occurring in other and far more important districts. What leads us to say this, is the passing of a resolution by them the other day instructing the Town Clerk to ascertain "If any other corporate authority had commenced supplying their districts with the electric light, and with what success." What led to the subject being considered was the application by an electrical engineering firm for liberty to supply the borough with electric light. There was an under-current of feeling among the Councillors that the Corporation should supply it if it could be done profitably.

Garston.—At the last Council meeting it was resolved to ask the promoters of the Electric Lighting Bill for the district whether they would reduce the maximum unit price to 8d., and whether within two years they would be willing to supply any part of the district when requested by the Council.

Halifax.—The Town Clerk is to apply to the Local Government Board for sanction to borrow £20,000 for electric lighting purposes.

Hastings.—The Council has given permission for four outside reflector electric lamps at Mr. E. Smither's premises, 19, London Road.

Islington.—According to the *Morning Advertiser*, while the last Vestry meeting was being held, the electric light suddenly went out, but as steps were being made to requisition the old gas lamps, the electric current was on again almost immediately.

London.—The Marylebone Vestry, on March 5th, decided, on the motion of Mr. Brooke Hitching, chairman of its electric light committee, to light Upper Regent Street with electric arc lamps. The cost will be £180 per annum, and the light equal to 6,000 candle-power. The present cost of gas—850 candle-powder—is £150 per annum.

Lambeth.—At a meeting of some of the ratepayers a few days ago, a resolution was passed emphatically condemning the action of the Vestry Electric Lighting Committee in refusing to receive a deputation on the electric lighting question.

Liverpool.—The *Liverpool Post* says that the city engineer has been authorised to conduct experiments with a view to using electric light in the sewers during repairs, &c.

Mevagissey.—At a public meeting on 9th inst. the advisability of celebrating the inauguration of the electric light in the streets, Mr. A. Roberts, the chairman, hoped the streets would be lighted by the 25th inst., and said Mr. Headly, of the electric works, had promised an electrical exhibition, and a lecture on "Electricity." A committee was appointed to confer with the Parish Council with reference to the proposed demonstration.

Monmouth.—The Board of Trade has approved the Council's electric light scheme for the borough.

Newmarket.—The surveyor's report on an electric lighting scheme having been considered, the Council is now applying for a provisional order.

Portsmouth.—The Electric Lighting Committee has just published its balance-sheet for 1895. The result of the year's working is not quite so good as was expected, but it is nevertheless satisfactory, especially in view of the reduction, by one-sixth, in the price at which energy is supplied to the public. The total expenditure for the year was £4,069 14s. 2d., and the revenue £6,533 8s. 8d. There was thus a gross profit of £2,463 14s. 6d., which would have been sufficient to pay a dividend of 3¾ per cent. on the outlay, had the works belonged to a private company; but as the money borrowed for the works, and interest thereon, has to be paid off in annual instalments, the balance is devoted to this purpose.

South African Notes.—From the *British and South African Export Gazette* we gather the following:—The Standard Buildings Company, Limited, Johannesburg, has ordered from Messrs. Parker, Wood & Co., for the lighting of its new buildings, two 36-unit dynamos of Messrs. Ernest Scott & Mountain's new Admiralty type. Each set will be capable of supplying current for 1,200 8-candle-power lamps at an E.M.F. of 110 volts. The dynamos will be driven by Willans high-speed compound engines, to which they will be directly coupled.—Messrs. Geo. Findlay & Co., Cape Town, have secured the contract for the installation of the electric light at Ohlsson's Breweries and Montebello House, Newlands, Cape Colony.—We understand that a number of electric meters are to be ordered by the Johannesburg Sanitary Board.—The narrowness of the streets and the character of much of the traffic will prevent the adoption of the centre pole system for the electrical tramways which are about to be constructed in Port Elizabeth. Either side brackets, or what is known as the suspension system, will therefore have to be employed.—A large electric plant is to be obtained for lighting and pumping on the Glenluce property.—The cyanide works on the Glenluce are to be installed with the Siemens-Halske precipitation process—In addition to the above, the following companies have placed orders with the Rand Central Ore Reduction Company for the installation of the Siemens-Halske process:—The Ginsberg, Van Ryn, Van Ryn West, and Witwatersrand.

Shrewsbury.—The Shropshire Electric Light Company have lately extended their supply mains down Mardol, and intend extending them in an opposite direction down Castle Gates, Chester Street, and Smithfield Road. If sufficient applications are received, they will extend to Kingsland also.

Stafford.—The Town Council has decided to extend the electric cables along Lichfield Road to St. Paul's Church at a cost not exceeding £250, and to extend the two ¼-inch feeders from Tipping Street to Lichfield Road, at a cost not exceeding £200. An agreement is being entered into with the County Council for the lighting of the County Council buildings, the Judges' House, and Eastgate House with electricity, for a minimum charge of £43 15s. per quarter, with a further charge of 8d. per unit for all current consumed over 1,312 units per quarter, the number of lamps not to exceed 1,200 8-C.P., or the equivalent thereof.

Salford.—The Council is to apply for the sanction of the Local Government Board to borrow £5,000 for electric lighting purposes.

Wimbledon.—The Local Government Board recently wrote to the Council declining to entertain the proposal of the Council to borrow £35,000 for purposes of electric lighting until the Council had obtained from the Board of Trade a renewal of their lighting license, and also intimated that they would then only be willing to sanction a loan for the period for which the renewed license was extended. The Board of Trade having expressed their willingness to extend the license for two years from the date of its expiration in October next, the Council decided to wait until that time, and then make application for a provisional order.

Weybridge.—The Board of Trade has revoked the order of the Weybridge Electric Supply Company.

Walsall.—The present number of consumers of electric current is stated to be 52. Instructions have been given for the laying of a cable to light the new baths at a cost of £78.

Yarmouth.—The statement for February showed that the receipts exceeded working expenses by £80 2s. 9d., but the charges for repayment of capital, interest, rates, and insurance, amount now to £100 per month. Five more customers have been obtained for 350 lamps, making the totals—150 customers for 6,997 lamps. The surveyor was directed to lay mains, &c., on the North Quay as soon as customers had been obtained in the district to the extent of £50 per annum.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accumulator Traction in Rome.—A French exchange says that since September 1st, 1895, a battery of accumulators has been introduced in connection with the Pie electric tramways at Rome. It is composed of 300 Tudor cells each having a capacity of 1,200 ampere-hours. Each cell is composed of 13 negative and 12 positive plates. These are composed of four small plates maintained by a strong lead frame. The charging current is 221 amperes. The battery will furnish a discharge current of 115 amperes for 10 hours, or of 285 amperes for three hours. A Trumpy automatic regulator, constructed by the Tudor Company at Hagen, will allow of adding, or taking away, a variable number of cells for maintaining a constant potential.

Barcelona Tramways and Electricity.—The chairman (Mr. E. M. Underdown, Q.C.) of the Barcelona Tramway Company's meeting on Wednesday, referred at length to electric traction. He said that the directors, after long study, had come to the conclusion that electric traction was an absolute necessity for a town like Barcelona. Additional capital is to be raised for installing the line, and the board has come to the conclusion that the new system will not only give an income amply sufficient to pay interest on capital, but will largely increase the dividend on the ordinary shares already existing.

Bristol Electric Tramway Extensions.—We hear that, in addition to the very considerable extensions in progress in connection with the electric tramways here, the cars on the existing line are being increased in number.

Cork Electric Tramways.—With further reference to this proposed line of electric tramways, we understand that a company, called the Cork Electric Tramways Company, Limited, intends to make application to the Lord Lieutenant in Council under the Tramways (Ireland) Acts, at the next Spring Assizes, and to the Corporation of Cork, for an order in Council to authorise the construction, working, and maintenance of tramways in the City and County of Cork, to be worked by horse-power, electrical, or other mechanical power.

City and South London Railway Extensions.—The petitions lodged in the House of Commons against the City and South London Railway Bill, on behalf of St. Paul's Ecclesiological Society, the Society for the Protection of Ancient Buildings, and the City Church Preservation Society, have been withdrawn.

Dublin Corporation and Rival Tram Companies.—An important and interesting question has arisen, says *Freeman's Journal*, in reference to the resolution passed by the Corporation granting the Dublin Southern District Company the right to lay a tramway line for horse haulage from Haddington-road to O'Connell Bridge. A protest has been lodged by Alderman Sir Robert Sexton with the Town Clerk, questioning the legality of the resolution and the power of the Lord Mayor to put from the chair the motion referring to the matter. It will be remembered that there were two reports from committees of the whole house before the Council, one dealing with the proposal of the United Tramway Company, which was first considered, and the other dealing with the scheme put forward by the Southern District Tramway Company for the introduction of electric traction into the city. On the motion for the adoption of the report as to the terms offered by the United Company, the Lord Mayor ruled out of order an amendment proposed by Councillor Beardwood deferring the consideration of the matter until a general meeting of burgesses was called to consider the question of introducing electricity at all. The ground on which this amendment was ruled out of order was that it dealt with electric traction while the report referred to an arrangement for the payment of way-leave for horse haulage. Ultimately it was decided on a division to postpone for six months the consideration of this particular report. The Council then proceeded to deal with the report of the committee of the whole house on the proposal of the Southern Company. This report dealt exclusively with the question of electricity, in reference to which a specially sealed agreement had been come to between the company and the Corporation to enable the company to comply with the Standing Orders of Parliament and place them in a position to proceed with their Bill if the Council should ultimately sanction the use of electric traction in the city. An amendment was proposed and agreed to, on a division, postponing the consideration of this report for six months. When the amendment was put as a substantive motion the Lord Mayor received as an amendment to that proposition a motion by Councillor Lenehan granting permission to the Southern Company to lay down a line of tramway to be worked with horse haulage from Haddington Road to O'Connell Bridge, and several members left the meeting protesting against the Lord Mayor receiving such a motion. Alderman Sexton lodged a formal protest on the subject. These members say there was nothing in reference to horse haulage in the report, and that if the Lord Mayor was right in ruling out of order a motion of Councillor Beardwood, dealing with electricity in reference to the proposal of the United Company, he was wrong in receiving a motion dealing with horse haulage as an amendment to a question which dealt exclusively with electric traction.

Dublin Electric Tramways.—We make the following extracts from the report just issued by the directors of the Imperial Tramways Company. The Dublin Southern District Tramways Company's lines being in course of reconstruction, the tramways have been closed to traffic for practically the whole of the period. The directors are disappointed that they are not in a sufficiently finished state to admit of any portion of the lines being opened for public traffic at the date of this report. There is every prospect that the lines will be ready for opening within the next few weeks. The company are promoting a Bill in Parliament in the present session, with a view to obtaining powers for considerable extensions of their electric tramways in the city and in the districts of Pembroke, Rathmines, Clontarf, and Drumcondra. The formal assents of all these four townships have been given. The whole of the projected lines can be operated from the location of the company's central power station. The Bill also provides for changing the name of this company to the "Dublin Electric Tramways Company."

Electric Locomotives in France.—A French contemporary says that the Compagnie de l'Ouest has conceded to the Heilmann Company the equipment for electric traction of their line from Saint-Germain-Ouest to Saint-Germain-Grande-Ceinture. The line has 4 kilometres of double track, and will have at Saint-Germain-Ouest generating plant of 800 to 1,000 horse-power. Two electric locomotives of 400 horse-power will haul trains of 8 to 10 carriages at 90 kilometres per hour.

South Staffordshire Tramways.—At Tipton District Council meeting on 25th ult., a letter was read from Mr. L. Schuster, chairman of the South Staffordshire Tramways Company, stating that the license to use steam on the company's tramways expired on March 25th next, and in order that the present service of cars might continue, he had made a formal application to the Board of Trade for an extension for one year. As the decision of the Board would be influenced by the wishes of the Council, he hoped they would support his application. Should the extension be granted, the directors hoped, before the period expired, to place before the Council serious proposals for introducing a new method of traction, which, owing to the position of the company, they had not yet been able to do.

The Horseless Carriage Bill.—In the Commons on Tuesday, Mr. Ritchie (the President of the Board of Trade) said that it was the intention of the Government to introduce a Bill for the amendment of the Locomotives Acts, with the object of legalising and facilitating the use of horseless vehicles, propelled by steam or electricity, on public roads. He could not, however, at present name the date on which the Bill would be brought in.

Tramway Haulage.—At the meeting of the Leeds Association of Engineers on 27th inst., there was a discussion on tramway haulage, several speakers favouring overhead electric traction, others, as might be expected, favouring cable and steam.

TELEGRAPH AND TELEPHONE NOTES.

Coast Communication.—The Royal Commission on the subject of electrical communication with lightships is now approaching the end of its prolonged investigation. The taking of evidence has been concluded, and the final report is expected to be presented shortly after Easter.

Japanese Cable Men in London.—Between 200 and 300 Japanese bluejackets are stated to be just now in London, having been sent over here to form the crew of the cable ship being built for the Japanese Government for the purpose of laying the telegraph cable between the Island of Formosa (which has recently passed into the possession of the Japanese) and Tokio. Many of the men took part in the recent naval battles.

Liverpool Telephone Service.—The Town Clerk of Liverpool has been instructed to prepare a report on the powers of the Corporation in reference to an application by the National Telephone Company to lay some of their wires underground.

New Cable.—We learn that the India-Rubber, Gutta-Percha and Telegraph Works Company are at present making 230 knots of 4-core cable for H.M. Post Office and the German Government.

Suspension of Telegraphic Communication with Western Australia.—In the Australian press of January 27th last we find the following:—"The Deputy Postmaster-General has received the following advice from the Postmaster-General, Perth:—'On account of the congested state of the Eucla line this department is reluctantly compelled to suspend urgent business with the other colonies for the present. Please accept no more urgent messages for Western Australia until further advised.'" In face of the above, which is only one of several of the interruptions which both the Australian trunk landlines have sustained since the beginning of this year, it is astonishing to find that Mr. Thomas Playford, the Agent-General in London for South Australia, is reported in the Australian press as being of opinion that "the projected Pacific cable would be wholly in Canada's interest." This gentleman, however, showed himself so inaccurately informed during the proceedings of the Conference at Ottawa that it would be imprudent to attach much value to his opinion.

The Protection of our Commerce in War.—From an article by Mr. H. W. Wilson, published under the above heading in the *Nineteenth Century* for February, we extract the following:—"To enable our squadrons to discover the whereabouts of hostile cruisers, the telegraph will be of inestimable value. Here, unfortunately, there are serious gaps in our system, and great lines, the use of which depends upon the goodwill of neutrals. Our West Indian Islands are connected with the United States by a line which passes through Cuba, and which is at present interrupted, owing to the Cuban insurrection. It would be useless, even if Cuba were pacified, should the United States assume a hostile attitude. It is, therefore, a matter of some urgency that the cable which runs from Halifax to Bermuda should be continued thence to Jamaica. Again, our whole Eastern and South African system depends upon the friendship of Portugal, as all the cables touch at Lisbon. This, perhaps, does not much matter, since Portugal, so long as we are supreme at sea, will be our friend. But if we allow the possibility of a disputed command of the sea, Portugal may be driven into an attitude of hostility, when we are cut off from the East and South. To avert such a disaster the proposed Pacific cable from Vancouver through the Fiji Islands, at present unconnected, to Australia is needed. Again, such an important point as Mauritius should not be overlooked. It is a coaling station, a strategic position of the utmost value, on the high road from India to the Cape. As such it should be linked by a cable with Natal. Little but money is required to fill these gaps, and even from a commercial point of view, the new lines proposed might soon pay their way. They would greatly improve our position. It is possible that some of our cables might be cut in war, though experts differ in opinion upon the practicability of this. It is hardly likely that all will be severed, and thus the more perfect we make our communications in peace, the less annoyance shall we suffer in war, as then the cutting of one or two lines will not bring us to a standstill."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Zanzibar-Mombassa	Mar. 6th, 1896 ...	March 9th, 1896.
Landlines.		
Communication with Matagalpa Provinces of Leon and Chinandega ...	Feb. 26th, 1896 ...	...
Carmen-Champoton, and communication with Campeche and Yucatan.	Feb. 28th, 1896 ...	March 8th, 1896.
Saigon-Bangkok	Mar. 4th, 1896 ...	March 4th, 1896.
Havana-Batabano cut on February 18th and March 6th	... ...	...

Telephone Extension in France.—A Dalziel telegram from Paris states that the arrangements for extending the existing through telephone service between Paris and Marseilles on to Cannes, Nice and Monte Carlo are now all but completed, and it is probable that within the near future it will be possible to converse with the Riviera at any of the Bureaux de Poste in Paris. At the same time, it is understood that negotiations are pending between the London and Paris postal departments, so that the London and Paris telephone may be connected with the French inland trunk wires. In this way when the extension wires from Marseilles to Nice have been put in working order it will be possible to communicate direct between London and Monte Carlo, or between London and any of the important French cities. It is also understood that the French Government is seriously considering the practicability of telephone communication between Marseilles and Algiers.

The Telegraph Wire Export Trade.—The returns which are now available regarding the exports from this country during last month, of telegraphic wire and apparatus connected therewith, are more satisfactory than for some time past, seeing that they show a value of no less than £109,840, as compared with £57,224 in the preceding month, and only £9,411 for February last year. During the first two months of the present year the value of the exports has amounted to £167,064, as compared with only £44,604 in the first two months of last year.

Telegraphic Communication with the West Indies.—With reference to our previous remarks regarding the necessity for extensions of the system of telegraphic communication with the West Indies, the following further comments on the question appeared in a recent issue of *Colonies and India*:—"There is a great prospect of official support being given to the Halifax and Bermuda Telegraph Company in regard to the extension of their cable to Barbados and Jamaica. There is no denying the fact that at present the cost of telegrams to the West Indies is too high, and that in England we labour under the disadvantage of obtaining the greater part of our telegraphic news *via* the United States. A debate, which has recently taken place in the Legislative Council of Barbados with regard to this company, clearly shows the saving in cost which can be effected, and the advantage which would accrue from subsidising the Halifax and Bermuda Company. It is a general cause of complaint in London that telegrams *via* New York cannot be relied upon, and that steps should be taken to obtain better communication with our West India possessions. Only last week a telegram was received in London stating that an insurrection had broken out amongst the Maroons at St. Elizabeth, in Jamaica; but nothing further is known, although the telegram was received several days since. Had a direct line been in operation, full particulars could have been given and much anxiety prevented amongst those owning estates in that district of the island. Although the West India and Panama Telegraph Company have had what may be termed a monopoly in the past, our Barbados friends clearly show under what a disadvantage we are for West Indian news, owing to the line passing through foreign territory. Only recently telegraphic communication was interrupted, owing to the disturbances in Cuba; but surely our West Indian Colonies are of sufficient importance to warrant the outlay of a subsidy to a cable company touching British territory only. It is for the various colonies to seriously consider this question, and to take that action which they think necessary to ensure more direct communication with Great Britain."

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection of and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Bangor.—March 18th. The Corporation invites tenders for the construction, supply, and laying down of the necessary plant and mains for the supply of electricity in the Borough.

Bucharest.—Notice is hereby given that on March 14th-26th, 1896, at 10 o'clock a.m., sealed tenders will be received for lighting the suburban districts of the City by some system which shall not require to be conveyed underground by means of pipes or otherwise, and which shall, in the opinion of the Board, be considered the most advantageous of all the systems submitted, with a view to substituting same for the 3,265 oil lamps now used for lighting the suburban streets and squares. The contract shall be given in accordance with the specification relating thereto, which has been drawn up by order of the Board of Technical Works, and approved by the Communal Council at a meeting held on January 24th, 1896. The said specification may be inspected any day during business hours at the offices of the Agence Havas, 96, Queen Street, Cheapside, London, E.C. The contract to be given for a term of five years, from April 1-13th, next, 1896, on which date the present contract runs out.

County Antrim.—May 1st. The Commissioners for the control of Lunatic Asylums invite tenders for the supply and erection of an electrical installation at County Antrim Lunatic Asylum. For further particulars see our advertisement pages.

Eston.—May 1st. The District Council invites schemes for lighting the district by electricity, such schemes to embrace (*a*) plan and estimated cost; (*b*) annual working cost and maintenance. Particulars from the District Surveyor, Grangetown, Yorkshire.

France.—March 24th. Tenders are being invited for the supply of 14 lots of paper rolls from 10 to 16 mm. wide for telegraphic apparatus. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

France.—March 25th. Tenders are invited for the supply of a number of telegraphic instruments, in eight lots. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Germany.—March 18th. The municipal authorities of Herne are inviting tenders for the concession for the construction of a tramway, to be operated either by means of gas motors or electricity, between Herne and Recklinghausen, a distance of about 9 kilometres. Tenders are to be directed to Der Verwaltungsausschuss, Herne, Germany.

Germany.—March 20th. Tenders are being invited for the supply of 1,600 incandescent lamps and 93,000 arc lamp carbons. Tenders to be directed to the Königliche Eisenbahn Direction, Central Bureau (Verwaltungs-Gebaude Zimmer 67) Altona.

Glasgow.—March 14th. Tenders are at present being invited for supplying a compound dynamo machine for the sewage purification works, Dalmarnock, for the Corporation. Particulars on application to Mr. Thomas Melvin, manager at the works.

Peru.—June 1st. The Municipal Authorities of Lima, Peru, are inviting tenders for the concession for the electric lighting of the city. Tenders are to be directed to La Legation de Perou, 8, Avenue Hoche, Paris, from whom particulars may be obtained.

Sunderland.—March 13th. Tenders for engines, dynamos, boilers, &c., for the electric supply station, have to be in to-day.

Wallasey.—The District Council is prepared to receive tenders for the undermentioned works, viz.:—*a*, Steam alternators, switchboard, and accessories; *b*, High and low tension concentric cables; *c*, Transformers. Particulars may be obtained on application to the Engineer, Mr. J. H. Crowther, at the Gas and Water Works, Great Float, near Birkenhead.

CLOSED.

France.—The General Direction of the French Posts and Telegraphs in Paris, has just placed a contract with Messrs. Lazare, Weiller & Co., of Paris, for 125 tons of bronze telegraph wire. They have also given an order for a quantity of telephone cable to M. Pilter of that city.

Marylebone.—The following tenders were sent in for electric light wiring, fittings, &c., at the new St. Marylebone Public Baths and Wash-house:—

L. Alwyn	£1,422 0 0
Strode & Co.	1,633 10 5
Emanuel & Co.	1,666 0 0
Roger Dawson & Co.	1,681 8 7
H. South	1,950 0 0
F. Suter & Co.	1,950 5 4
F. A. Donnison & Co.	2,050 0 0

St. Helen's.—The Gas and Lighting Committee have decided to accept the tender of Mr. W. Molyneux, of Parr, for the erection of the new electric lighting works.

BOOKS RECEIVED.

Kosto-Komparatibo en Chile del Gas i de la Elektrizidad Komo Sistemas de Distribuzion de Enerjia. By A. E Salazar and K. Newman, Santiago.

Engineering Estimates and Cost Accounts. By F. G. Burton. Published by the Technical Publishing Company, Manchester. Price 3s.

CITY NOTES.

Liverpool Electric Supply Company.

The mutability of Parliaments affects very nearly the interests of the electrical industries. It would not be difficult to give many instances of this in the past. The transfer of the Liverpool Company's undertaking to the Corporation has been delayed simply because the Liberal Government saw fit to resign, but it is extremely probable that we are examining the company's accounts for the last time. We said the same thing last year, but that only shows the danger of prophesying without adequate knowledge. Still, as it is stated that the Bill will receive the Royal assent by Easter, it is fair to assume that the matter will be settled by Midsummer. The last year's accounts show that the Corporation of Liverpool are likely to acquire a good bargain, for there has been not only a great increase in business, but the actual expenditure is very little in excess of what it was last year. The total cost of coal is actually less than

it was last year, but that is no doubt partly accounted for by the fact that the year 1894 was considerably affected by the coal strike. Still, to increase the output by 170,000 units, with practically the same wages for generation, and with very little increase in management costs, is especially noteworthy. A consideration of the following figures will be interesting:—

The following table gives the cost per unit:—

	1893.	1894.	1895.
Total capital expended ...	£214,222	£252,152	£264,711
Number of units sold	873,325	1,016,178	1,185,964
Number of lamps connected ...	25,000	31,792	—
Revenue from sale of current...	£24,735	£28,906	£33,994
Net revenue	£9,589	£15,898	£18,821
Average price obtained per unit	6·9d.	6·8d.	6·7d.

Cost of production.	£	s.	d.	Per unit.
Coal	2,703	0	0	·54d.
Oil, waste, water, and engine room stores	508	0	0	·11d.
Salaries and wages at generating station	1,095	0	0	·22d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	2,777	0	0	(Works' cost 1·43d.) ·56d.
Rates and taxes	1,262	0	0	·25d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	3,776	0	0	·76d.
Depreciation of buildings and plant account	4,552	0	0	·91d.
Renewal fund account	3,000	0	0	—
Total	£19,673	0	0	3·35d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	33,944	0	0	6 7d.
Meter rents	1,370	0	0	—
Sale of lamps	425	0	0	—
Total	£35,739	0	0	6 7d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·44d.; works' cost, 1·43d.

Worcester Corporation Accounts.

Though an examination of the Worcester accounts might be a little disappointing, it would not be fair to criticise the undertaking at the close of its first year's work. There has not been the full benefit derived from the water-power which was anticipated, for the summer was, no doubt, an exceptionally dry one. In spite of this, the cost of production is distinctly good, and leads one to hope that Mr. Ruthven Murray will yet be able to compete with the most efficient works. The unfortunate thing for the undertaking is the extraordinarily low price received per unit. This is due to the fact that the waterworks—one of the largest consumers, pay 1d. per unit, an arrangement which cannot be considered a happy one for the electric lighting works.

The following report of the engineer to the Electricity Committee ought to disarm criticism:—

"In order that you may better realise the result of last year's working, I have analysed the return and accounts in such a manner that a comparison may be made between our own figures and those published by other electricity supply stations, and in making these comparisons the charges for interest and sinking fund have been excluded.

"Taken as a whole, our total costs figure of 2·97d. per unit sold is decidedly satisfactory, although it is higher than I anticipated. Nevertheless, if the average price obtained, 3·163d., were not so extremely low, we should have made a substantial profit.

"Undoubtedly the figure in the costs which looks out of proportion is that of 1·06d. per unit sold, for fuel; and in the reduction of this figure I see most hope of lowering the cost of generation in future.

"There are several reasons why this figure is so large, and pre-eminent is the fact that the available water power did not come anywhere near its calculated value, with the result that from the end of May until the end of November it was necessary to run a portion of the day on steam only. About midsummer there was so little water in the Teme that as much as 75 per cent. of a total week's running hours were done on steam power. As the engines at the works are all of 286 indicated horse-power, we had no choice but to run these at the very low load which was the maximum that could be obtained, and at a load factor so small that high efficiency and low consumption of steam, and therefore of fuel, was impossible. A condenser was thought unnecessary when the works were equipped, but this omission is now made good, and will, I have no doubt, effect an economy in the steam consumption of the engines of upwards of 20 per cent.

"Before it became necessary to run by steam power in the day time, we were using Staffordshire coal entirely, but in consequence of repeated complaints about smoke, you instructed me to burn Welsh smokeless coal when found necessary, which, being considerably more expensive is an important factor in the cost of fuel. The reason for so much coal being used was to keep running for the electric pumping plant at the waterworks. I estimate that not less than 400 tons of coal were used entirely to keep one motor running during the summer. As the price we received from the Water and Sewerage Committee was only 1d. per unit, it will be seen that over the whole year our costs show a higher figure than this for coal alone, and instead of making anything out of the day load found by these motors, you have actually lost money by having them on circuit.

"During the summer the contractors were engaged in replacing the coils of the alternator armatures with others of improved type, and to test them it was necessary to run the machines for many hours continuously. As no water power was available, steam had to be used, and testing accounts for some 80 tons of coal.

"It is authoritatively stated that the past summer was one of unusual drought; therefore we may not be so short of water during the coming season.

"We have recently improved the figure for cost of engine-room stores by alteration of the lubricating arrangements on the machinery at the works. Of the figure ·267d. per unit, ·156d. is engine room stores. The figure of ·111d. for carbons is not a true result of the year's working, as the carbons used during the few months of last year were altogether omitted, and have been added here. We are now purchasing carbons at about 22 per cent. less than we were during last year, and in the next report the figure of ·267d. per unit will be materially reduced.

"The next figure of 1·088d. per unit for wages at works is low for the character of the station, and cannot be reduced, except in so far as it will be from the larger output we may expect this year. It is apparent that this will fall proportionally as the output rises; the same remark applies to the figure for repairs and maintenance, which I do not anticipate will much increase. The figure which includes legal expenses, management and insurance, may be altered other than proportionally, although the figure for rates, taxes and rents should share in the reduction from increased output.

"Turning from costs to revenue, the most striking item is that of the average price obtained, which, excluding revenue derived from meter rents, property rents, &c., only amounts to an average of 2·73d. per unit, a figure without parallel in the annals of the electricity supply business. The figure, including revenue from other sources, 3·16d., is lower than any recorded. The waterworks motors are again mainly responsible for these figures. They were supplied with 103,644 units, for which we received the sum of £431 17s. This number of units bears the relation of 41·9 per cent. to the total output of 246,912 units. For the remaining 58·1 per cent. (143,268 units) we received £2,386 8s. 2d., or an average of 3·99d. per unit, a figure above the lowest on record of other stations.

"Bearing in mind the unusual difficulties we have had to engage with and overcome during the past year, our results cannot but be considered satisfactory. The number of lamps we have taken on is very gratifying, amounting to an increase of over 200 per cent., and I have no doubt, from information received, that we shall have a large accession of small consumers, from whom we derive a much better revenue per lamp than from most of the larger ones during this year.

"E. T. Ruthven-Murray."

Water and Steam Power.

The following table shows the percentage of hours running by water and steam power during the past year:—

	January to June.	July to December.	Whole year.
Water alone ...	85 per cent.	49 per cent.	67 per cent.
Steam alone ...	10 „	40 „	25 „
Water & steam	5 „	11 „	8 „

The following table gives the cost per unit:—

	1893.	1894.	1895.
Total capital invested ...	—	—	£52,226
Number of units sold	—	—	246,912
Number of lamps connected ...	—	—	13,522
Revenue from sale of current...	—	—	£3,046
Net revenue	—	—	£196
Average price obtained per unit	—	—	2·4d.

Cost of Production.	£	s.	d.	Per unit.
Coal	1,092	0	0	1·06d.
Oil, waste, water, and engine room stores	161	0	0	·16d.
Salaries and wages at generating station	1,025	0	0	·99d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	306	0	0	(Works' cost 2·45d.) ·30d.
Rates and taxes	45	0	0	·04d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	404	0	0	·39d.
Depreciation of buildings and plant account	—			—
Sinking fund account	953	0	0	·92d.
Total	£3,986	0	0	3·86d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	2,481	0	0	2·4d.
Meter rents	132	0	0	—
Sale of lamps	—			—
Total	£2,613	0	0	2·4d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·94d.; works' cost, 2·45d.

W. T. Henley's Telegraph Works Company, Limited.

The directors' report, to be presented to the shareholders at the meeting to be held at the company's offices to-day, March 13th, at 2 p.m., says that, as shown by the accounts, a net profit has been made during the year of £21,823 19s. 5d. After payment of debenture interest and income-tax, and making an allowance for depreciation of plant, machinery, &c, there remains £17,342 9s. 2d., to which must be added £1,600 7s. 9d., the final dividend received from the International Cable Company, Limited, and £8,624 9s. 3d. brought forward from last year, making a total of £27,567 6s. 2d. From this must be deducted £2,100, the interim dividend of 3 per cent. paid on the ordinary shares on August 1st last, and £1,050, the half-year's dividend on the preference shares paid in October, and there remains a balance of £24,417 6s. 2d. Of this sum the directors have transferred £5,000 to reserve fund, and they propose the payment of the remaining half-year's dividend on the preference shares at the rate of 7 per cent. per annum, and a further dividend of 5 per cent., free of income-tax, on the ordinary shares (making a total distribution of 8 per cent. for the year, free of income-tax, on the ordinary shares). These payments together absorb £11,050, leaving £13,367 6s. 2d, to be carried forward. In the month of July last an issue was made of 3,000 ordinary shares, which were all subscribed for by the shareholders at par. The directors who retire on this occasion, in accordance with the provisions of the articles of association, are Mr. Sydney Gedge, M.P., and Mr. Frederick Newton, who being eligible, offer themselves for re-election. The auditors, Messrs. Ball, Baker, Deed, Cornish & Co., retire, and being eligible, offer themselves for re-election.

The Brush Electrical Engineering Company, Limited.

The interim report to the shareholders for half-year ended December 31st, 1895, says that the works have been fully employed during that period on central station and other orders. No large contracts have been entered into, but the volume of smaller orders has been well maintained, and additional large contracts are in course of negotiation. The new type of direct driven alternating plant has proved satisfactory, recent tests made by Profs. Kennedy and S. P. Thompson for the Dover Electricity Supply Company having yielded very good results, both as regards the economy and efficiency of the machinery supplied by the company. A specially favourable feature to which attention is drawn is that the machines remain practically cold after a prolonged run at full load. Negotiations are proceeding for an amicable settlement of the company's claim against the City of London Electric Lighting Company for plant supplied. The company's Austrian and Australasian branches are showing improved results. The development of electric traction is being actively pushed forward, and important orders are anticipated from this source. The new high-speed engine designed by the company's chief engineer has been fully developed and tested, and has given satisfactory results. Steps are now being taken to place it upon the market, and the directors anticipate a large sale of these engines for general application, as well as for electrical purposes. The Board are making efforts to institute and maintain economies in every department. With this object, the policy of concentration at the works at Loughborough, Leicestershire, which has been referred to in several of the recent reports to the shareholders, is being consistently followed as opportunity arises by expiration of leases or otherwise, for the disposal of the London premises. Though these economies will not make themselves fully felt during the present financial year, their ultimate result upon the administrative charges of the company will be of a very substantial character. During the half-year the issue of £105,000 4½ per cent. redeemable second mortgage debenture stock mentioned in the last report has been offered to the shareholders, and £76,770 has been allotted. The balance is held in reserve for issue at a premium when necessary, but the company's funds are ample for all present requirements. The directors do not propose to declare an interim dividend, preferring to await the result of the complete financial year, which closes on June 30th.

Dover Electricity Supply Company, Limited.

We have received the following from the secretary of this company, Mr. Frank E. Beeton:—

Sir William Crundall presided at the second annual meeting of the shareholders of the Dover Electricity Supply Company, Limited, held at the offices, Park Street, Dover, on Wednesday, March 11th, 1896. He stated, in moving the adoption of the report and accounts, that the directors had reason to be satisfied with the position of the company, bearing in mind the fact that they had not yet been working for a year. At the present time they had the equivalent of about 5,000 8-C.P. lamps connected, with promises of support in various directions, including the Lord Warden Hotel. The directors hoped that the reduction in price which had been made would induce many of the townspeople of Dover to take up the light. It brought the price of the current down to nearly the price of gas, and he thought that in view of the luxurious light given by electricity, and the freedom from damage to health and to decorations, it would be recognised as true economy to instal it. Another point he would like to touch upon was the prospect of electric tramways in Dover. He did not think that it would be long before this was accomplished. The provisional order would be obtained in the summer, and the working men of Dover would compel the early carrying out of the scheme. He thought that this company would be able to offer inducements for the supply of the current, which it would be in the interests of the Council and the ratepayers to accept rather than go to the expense of erecting a station and laying down costly plant of their own.

Mr. W. G. Lewis stated that, speaking as a churchwarden of the Buckland church, where the light was installed at the commencement of the company's operations, he had pleasure in confirming this year the results and expectations he expressed at the general meeting of the previous year. Based on the consumption to this day, the total cost for the year ending March 31st, 1896, would be £9 14s. 6d., as against £12 5s. expended for gas in the previous period of twelve months.

Mr. B. H. Van Tromp, one of the directors, mentioned that he had recently visited Bristol and noted the enormous increase in traffic brought about by the facilities afforded by electric traction. He suggested that in their own interests the landlords of Dover would do well to fit up houses for electric lighting, charging a small rate of interest on the outlay, as houses so fitted would command an increased rental.

The report and accounts were adopted, the retiring directors and the auditor re-elected, and the proceedings terminated with a vote of thanks to the chairman, directors, and staff.

Commercial Cable Company, Limited.

The report for 1895 states that the gross earnings amounted to $2,009,738, and the working and other expenses to $794,340, leaving a balance of $1,215,398. There was an increase in the earnings of $236,304, and an increase in expenses of $31,345, as compared with the returns of the previous year, resulting in an increase in net earnings of $204,959. Dividends of 1¾ per cent. for the quarters ending March 31st, June 30th, September 30th, and December 31st have been paid; a total of 7 per cent. for the year on the capital stock, amounting to $700,000. The reserve fund has been augmented by the purchase of $200,000.00 United States Government Bonds. The balance of the year's profit, amounting to $315,398, remains to the credit of profit and loss. Six sections of the cables were interrupted at different periods during the year, chiefly caused by contact with anchors of fishing vessels. The repairs were, however, promptly effected. The whole system is in excellent condition.

Scottish Westralia, Limited.

The statutory meeting of the shareholders of Scottish Westralia, Limited, was held the other day at Dashwood House, London, Mr. Robert Thomson presiding.

The Chairman, after dealing with the Stanley and Zealandia group of mines, adverted to the proud position occupied by the Scottish Westralia, in being virtually the foster-mother of the Westralian Electrical Corporation, which was undoubtedly the greatest scheme ever devised in connection with the working of gold fields in any part of the world. When operations were commenced, the conditions ruling on the Yilgarn and Coolgardie Gold Fields would be revolutionised. With the supply of electrical power to the mines, the water and fuel difficulties will be practically solved, and the cost of working mines will be greatly lessened.

The Western Union Telegraph Company, Limited.—This company has declared the usual quarterly dividend of 1¼ per cent. The statement for the quarter ended March 31st shows estimated net earnings of $1,250,000, an increase of $85,000; and the surplus, after providing for the dividend just declared, stands at $7,837,023, an increase of $577,014.

The Direct Spanish Telegraph Company, Limited.—The board has decided, subject to audit, to recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend, free of income-tax, at the rate of 4 per cent. per annum on the ordinary shares, both for the half-year ended December 31st, 1895.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending March 8th, 1896, were £977; week ending March 10th, 1895, £971; increase, £6; total receipts for half-year, 1896, £9,837; corresponding period, 1895, £9,911; decrease, £74.

The Great Northern Telegraph Company. The traffic receipts in February 1896, were £22,000; 1st January, 29th February, 1896, £44,400; corresponding months, 1895, £44,400; corresponding months, 1894, £41,000.

The Liverpool Overhead Railway Company. The receipts for the week ending March 8th, 1896, amounted to £1,040; corresponding week last year, £937; increase, £103.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 6th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,777.

NOTES.

Electric Railway Business.—The New York electrical press gives abundant evidence of the enormous electric railway and tramway business done in the United States. It also makes more acute the impression that has been brought home to us so very forcibly of late, of the back seat we, in England, occupy in regard to this branch of electrical industry. Contractors here have waited long and patiently for the business to come, though there has been plenty to occupy them in electric lighting developments, and the time for traction seemed hardly ripe. But works have continued to extend, giving increased opportunities for executing new contracts, and we believe we are correct in saying that there is not a man connected with the electrical science, in either theory or practice, who would not, along with the contractors, hail most cordially the arrival of traction business. Let us hope it will not longer delay. It is coming. Of that there are sure signs, but its pace is incredibly slow. Yet we may be pardoned if we are so sanguine as to anticipate that, in the course of a few years, the short note which we now give from the *Scientific American* may be faithfully applied to electric traction affairs in this country also :—

Electric railroads are proving of great benefit to the farmers in all parts of the country (U.S.). The trolley lines run out from the large cities and towns to villages far removed from steam railroad communication, and in several districts arrangements are making to run trolley milk trains, vegetable trains, and the like, to enable the farmers to get their produce quickly to market. It is even proposed to run trolley coal trains, to supply coal to small towns that now use only wood.

Fire Hazards from Telephone Wires.—A circular recently issued by the Boston Manufacturers' Mutual Fire Insurance Company, relating to fire protection, gives the following to cover the hazard from telephone wires :—

Prof. Puffer has made special tests with the latest protectors of the American Bell and New England Telephone Companies, which are designed to guard against the dangers of crossing of telephone wires by wires carrying currents of great capacities at pressures varying from 500 to 2,000 volts. In all cases there was a report and a flash of fire when the protector operated. It seemed that if the protector was covered with fine lint, or near a light curtain, or the most positions where likely to be used, there would be little or no danger from the flash of the fuse. The protectors are much alike in design, that of the New England Telephone Company being rather the better. Though some improvements are still desired in both protectors, they are in their present shape so good that their immediate use is advised and believed necessary for safety on all telephone wires.

When we come to the great class of private wires for bells, watch clocks, telephones not the property of the American Bell Telephone Company, but often running out of doors where subject to contacts with high voltage wires, it is easy to find the greatest risk of fire, because there is usually no attempt to make use of protectors of any kind. There being no demand for such a thing, there seems to be but very little offered by the trade.

The best remedy is to so run these wires wherever possible that they could not fall on, or be fallen upon, by foreign wires of any kind. It may be noted that any foreign wire may be dangerous, though nominally carrying a harmless current, as it may itself be in contact with a high voltage wire. When wires cannot be completely isolated, protecting devices equal to those of the telephone companies are necessary for safety, and should be used as soon as something satisfactory can be developed.

The Institution of Junior Engineers.—On Saturday, 29th ult., the members of this Institution visited, by invitation of the directors, the National Skating Palace, to inspect its engineering features. The two main refrigerating engines of this installation were supplied by Messrs. J. & E. Hall, and are each capable of making 25 tons of ice per 24 hours. The electric light engines, supplied by Messrs. Crompton & Co., are of the inverted vertical compound type, and indicate 57 H.P. at 250 revolutions per minute. Three Davey-Paxman 40 nominal horse-power boilers of the locomotive type supply steam. The water is obtained from a well 353 feet deep, which was sunk by Messrs. Tilley & Sons. The steam from the main engines is condensed in jet condensers worked by the engines themselves, and that from the electric light engines by an evaporative condenser situated on the roof, the air pump being worked by an independent engine.

The Royal Society.—Yesterday afternoon the Croonian Lecture on "Observations upon Isolated Nerve: Electrical Changes a Measure of Physico-chemical Change," was delivered by Dr. A. D. Waller, F.R.S.

An Electrical Expert.—A correspondent writing to *Pearson's Weekly*, asks: "Can you tell me whether it is possible to heat water with the wires of an ordinary electric light system?" The electrical expert on the staff of our ever entertaining contemporary replies:—"I must inform my would-be economiser that there are two separate and distinct electric light supplies, the one being a 'constant supply,' the other an 'alternating supply.' The former epithet is used when the electricity flows in one continuous stream; the latter when the current alternates, or flows backwards and forwards. Should the house of my friend 'Suburban' be supplied with a constant current, there is every possibility of his being able to heat his water with the ordinary wires. He must first, however, join the two wires each to a separate piece of lead or zinc, and place them at opposite ends of the bath or vessel containing the water to be heated. In a few minutes the liquid will be found hot enough for ordinary purposes." As this wonderful achievement in electric heating seemed to leave Crompton nowhere, we immediately set about figuring it out, with the following result. We will confine ourselves to the constant current, since Pearson's expert seems to consider that the alternating current has no heating effect. The resistance of a centimetre cube of pure water is 2,650 ohms; if two lead plates are placed 6 feet apart in a bath of this water, and connected to 100-volt circuit, the current per square centimetre of section will be approximately $\frac{1}{5000}$th ampere. The rise of temperature in degrees Centigrade per hour will be $C^2 R \times \cdot 24 \times 60 \times 60 = \cdot 08$, that is to say, "Suburban" will have to wait 12 to 13 hours before the temperature of his bath rises 1° C. Nothing is said about insulating the lead plates; if they were hooked without insulation on the ends of a metal bath, the consequences would be serious to the electric lighting in the suburban villa. *Pearson's Weekly* often tries to be funny, and sometimes succeeds; but in this case its scientific expert has succeeded in being funny without trying.

Magnetic Qualities of Forged Material.—We have received a copy of a report made by Prof. Ewing on the "Magnetic Qualities of a Sample of Forged Material for Dynamo Magnets," for Mr. R. Jenkins, of 88, Bishopsgate Street Within, London. It is not necessary to give the professor's figures; we therefore only quote his general conclusions, which read as follows :—

This is the best sample of forged material that I have met with. Its permeability, especially for inductions such as are used in dynamo magnets, is remarkably high. The B—H curve is almost coincident with a curve for "pure iron" given in the *Proceedings* of the Royal Society for June 16th, 1892. Most forgings and steel castings give results which lie considerably below the "pure iron" curve, and I have never before tested a specimen which approaches it so nearly as this does. The hysteresis losses are small in comparison with those generally found in forged metal; it is only in the best samples of thin transformer plates that I have found less. The general result of the test is to show that, in regard to magnetic quality, this is first-rate material for dynamo magnets.

Niagara-Buffalo Transmission Scheme.—It seems that this enterprise is being pushed forward now, the contract for the wooden poles which are to be used in the transmission line from the Falls power house to Buffalo being announced. The poles will be of Canada cedar, all 8 inches in diameter at the top, and ranging from 25 to 50 feet in length. They will be set ordinarily 50 to the mile, but where exposed to unusual wind strains, &c., 100 to the mile will be used. The poles will have two cross-arms. The current, as already noted, is to be transmitted three-phase from point to point. The New York *Electrical Engineer*, in its February 26th issue, says :—"Within the last week or two the wintry condition of the weather has interfered greatly with the flow of water over the Falls, and it is said that not since 1848 has there been a season when the Niagara River has so closely approached the state of the Red Sea when Pharaoh and his host essayed to cross it."

Electrical Engineering in Hungary.—An electric power transmission plant is being installed by Messrs. Siemens and Halske, of Vienna, at the gold mine of the Ruda-Zwolfapostel Gowerkschaft, at Brad, near Deva, Hungary. The plant will comprise a 63 kilowatt "Drehstrom" dynamo, which will supply the necessary electrical energy for the operation of a winding engine and the ventilating plant.

Lectures.—In Gordon's College, Aberdeen, under the auspices of the Aberdeen Mechanical Society, a paper was read on 3rd inst., by Mr. Walter Dixon, on "Recent Improvements and Applications in Electrical Machinery for Power Transmission Purposes."

At the Midland Institute Scientific Society meeting at the Birmingham Technical College on 4th inst., Dr. Sumpner lectured on "Some Curiosities of Magnetism."

At Lyme Regis Mr. Gibbons has just concluded a series of seven lectures on "Magnetism and Electricity."

At Carpenter's Hall, last week, Mr. W. H. Preece, C.B., lectured on "Electricity in Connection with Building."

A New Röntgen Ray Tube. — In a paper read before the Society of Arts, on the 4th inst., that indefatigable worker, Mr. A. A. Campbell Swinton, described a "new" Röntgen ray tube, having a concave cathode plate and an internal (centrical) emission surface. The design referred to is obviously based upon suggestions published in our contemporary, the *Optician* of 13th ult. (See *Journal* Soc. Arts, March 6th, 1896, p. 361, and *Optician*, February 13th, 1896, p. 290.)

The Salters' Company's Research Fellowship.—The Executive Committee of the City and Guilds of London Institute have awarded the second Salters' Company's Research Fellowship for the encouragement of higher research in chemistry in its relation to manufactures to Sidney Williamson, Ph.D., F.I.C., F.C.S., who was for two years a student at the City and Guilds Technical College, Finsbury, and subsequently for three years at the City and Guilds Central Technical College.

An Accumulator Competition.—The Société Industrielle de Rouen is offering a gold medal for an improved accumulator possessing advantages as regards efficiency, &c., over existing types. Competitors are to send in their models, &c., by the 30th inst. to the Société Industrielle de Rouen (2, Rue Ampère et Place de la Cathedrale), from whom full particulars of the competition may be obtained.

Electric "Autocar" for Her Majesty.—A Glasgow exchange says that an electric chaise was ordered by the late Prince Henry of Battenburg for H.M. the Queen. The body of the carriage will be "composed of aluminium, and it runs upon three wheels, fitted with michelin tyres; the car is propelled by means of Fulmen accumulators."

The Institution of Electrical Engineers.—At a students' meeting, to be held in the library of the Institution, 28, Victoria Street, on Friday, March 20th, at 8 p.m., the following paper will be read:—"Some Distinctive Features of Continental Electrical Engineering Practice," by Kenelm Edgcumbe and Edmund J. Fox, students.

The Portrush System.—In his article on the "Underground Trolley System of New York," which we reprint elsewhere, the writer makes a curious error in describing the Portrush tramway as an underground conduit system.

German Electro-Technics.—We learn that the Government of the Grand Duchy of Hesse has just voted a sum of £7,000 for the enlargement of the Electro-Technical Institute at Darmstadt, opened in January last year.

Plymouth Appointment.—For the post of electrical engineer to the Council, Mr. J. H. Rider, of Bolton, has been appointed. There were 40 applications for the position.

Obituary.—Mr. Bradshaw Brown, the well-known City auctioneer and surveyor, met his death a few days ago by being thrown from his horse at Blackheath. Mr. Brown was also known in electrical circles.

The Earl's Court Exhibition, 1896.—We understand that the idea of an electric railway in connection with this year's Exhibition has been abandoned for 1896.

Accident Due to Gas.—An explosion of gas occurred at the County Hall, Warwick, on 5th inst., Mr. Makepeace (a steward) being thrown to the ground.

Correspondence.—We regret that pressure upon our space compels us to hold over two letters on the "Wiring Question" until next week.

NEW COMPANIES REGISTERED.

Bullers, Limited (47,078).—This company was registered on March 4th with a capital of £100,000 in £5 shares, to acquire the business of a company of the same name, to adopt a certain agreement, and to carry on the business of mechanical, manufacturing, electrical, telegraphic, and general engineers and contractors, iron, brass, and other metal founders, and makers, merchants, and agents, &c. The subscribers (with one share each) are:—H. C. Jobson, Summerhill, Kidderminster, engineer; J. T. Harris, Radfords Stone, Staffordshire, engineer; E. J. Chambers, Castle Cottage, Dudley, engineer; E. P. Jobson, Castle Cottage, Dudley, solicitor; W. Greenhill, Castle Cottage, Dudley, bank manager; T. R. Griffiths, 40, Hall Road, Handsworth, clerk; H. C. Pinsent, 39, Waterloo Street, Birmingham, solicitor. The number of directors is not to be less than two nor more than seven; qualification, 200 shares; remuneration as the company may decide. Registered by Waterlow Bros. and Layton, Limited, Birchin Lane, E.C.

Canute Syndicate, Limited (47,065).—This company was registered on March 3rd with a capital of £1,500, in £1 shares, to acquire, develop, turn to account, and deal with any patented inventions for substances suitable for use in the manufacture of electrical fittings and appliances. The subscribers (with one share each) are: F. G. Perks, 2, Clement's Inn, W.C., gentleman; H. D. Baldie, 58, Hunsden Road, New Cross, gentleman; C. J. Jones, 7, Hunsden Road, New Cross, agent; W. R. Mungeam, 120, Branksome Road, Brixton; E. C. Green, 41, Oakley Road, Canonbury, clerk; C. Lott, 15, Kirchen Road, Ealing, clerk; J. H. Webb, 158, Gladstone Buildings, Finsbury, clerk. Registered without articles of association by Leighton and Savory, 3, Clement's Inn, London, W.C.

Williamson & Joseph, Limited (47,131).—This company was registered on March 9th with a capital of £10,000 in £1 shares, to adopt an agreement with E. L. Joseph, and to carry on the business of electrical and mechanical engineers, suppliers of electricity, and manufacturers of electrical apparatus. The subscribers (with one share each) are:—H. Glenister, 61, Victoria Road, Kentish Town, clerk; C. E. Wellaby, 5, Sussex Villas, Leytonstone, accountant; F. C. Moore, 16, Downs Road, Clapton, secretary; T. M. Middleton, 13, Hart Street, Bloomsbury, journalist; E. H. Minton, 5, Nelson Square, S.E., publisher; G. H. Congleton, Homecot, Streatham, traveller; A. A. Jones, 22, Great Winchester Street, E.C., clerk. The number of directors is to be three. Registered by M. Moseley, 303, Strand, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Eastern Telegraph Company, Limited (6,368).—This company's annual return was filed on February 21st. The capital is £4,700,000, in £10 shares. 469,989 of these have been taken up, and fully paid for.

Direct United States Cable Company, Limited (11,597).—This company's annual return was filed on February 11th. 60,710 shares have been taken up out of a capital of £130,000 in £20 shares, and all are considered as paid.

St. James's and Pall Mall Electric Light Company, Limited (26,015).—This company's annual return was filed on February 26th. The capital is £200,000, in 19,980 ordinary and 20,000 preference shares of £5 each, and 100 founders' shares of £1 each. The whole of these have been taken up, and the full amount called and paid.

Lineff Electric Traction and Lighting Syndicate, Limited (27,246).—This company's annual return was filed on January 4th; 11,431 shares have been taken up out of a capital of £15,000 in £1 shares; 8,003 have been issued as paid, and £3,428 has been paid on the rest.

Newcastle and District Electric Lighting Company, Limited (28,022).—This company's annual return was filed on February 28th. The capital is £100,000 in £10 shares; 5,000 of these have been taken up, £8 per share has been called, and £40,000 paid.

Yorkshire House-to-House Electricity Company, Limited (29,235).—This company's annual return was filed on February 24th. The capital is £100,000 in £5 shares (of which 100 are founders'). 18,848 ordinary and 100 founders' shares have been taken up, and the latter issued as paid. £5 per share has been called on 10,000 ordinary, and £2 per share on the rest. £70,890 has been paid, leaving £5,438 outstanding. Four ordinary shares have been forfeited.

Elmore's Wire Manufacturing Company, Limited (31,044).—This company's annual return was filed on January 24th. The capital is £300,020, in £2 shares (of which 133,500 are ordinary, 16,500 preference, and 10 founders'); 67,278 ordinary, 15,000 preference, and 10 founders' shares have been taken up, £2 per share called, £162,174 10s. paid, and £2,966 10s. left in arrears; £565 has been paid on 1,610 forfeited shares.

Elmore's American and Canadian Patent Copper Depositing Company, Limited (35,671).—This company's annual return was filed on January 22nd. The capital is £200,000, in £65,000 priority and 35,000 deferred shares. All the latter have been taken up, and issued as fully paid. 44,788 priority have been taken up, the full amount called, £86,044 15s. paid, and £3,531 5s. unpaid.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, March 4th.	Closing Quotation March 11th.	Business done during week ended March 11th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10¼— 10⅜	10½— 11	10⅜	10¼
1,912,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	46 — 48	46 — 48	47⅜	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	87 — 88	87½ - 88½	88¼	87½
2,993,560£	Do. do. Defd.	Stock	...	...	...	7½— 7⅝	7 — 7½	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	14½— 14⅝	14¼ — 14⅜	14⅝	14 3/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 - 115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3½	3 — 3½	3⅜	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½ %	...	¾— ⅞	¾— ⅞	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½xd	12½ — 13½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½ — 21½xd	20½ — 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	105 —108	105 —108 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	...	9 — 9½	9¼— 9⅝	9½	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	...	17 — 17½	17 — 17½	17½	17
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	18⅝	18 1/16
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	105 —108	105 —108	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	129 —132	129 —132	131	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17¾ — 18¼	17¾ — 18¼	18¼	18
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	101 —105	101 —105	104	101½
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	128 —131	128 —131	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	105 —108 xd	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	112 —115 %	112 —115%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	...	10 — 10¼	10¼— 10⅜	10⅜	10 5/16
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16¾ — 17¼	16¾— 17¼	17	16 13/16
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	...	22¼— 22⅝	22¼— 22⅝	...	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	102 —105	102 —105	105	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	46 — 49	47 — 50	48½	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	103 —108 xd	105 —108	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000...	5	4 %	4 %	...	2 — 2½	2 — 2½	2⅛	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	6⅝ — 6⅞	6¾— 7	6 15/16	6 13/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17⅜	16¼
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16 — 17	16½ — 17½	16 15/16	16⅜
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅝ — 6⅞	6⅝— 6⅞	6¾	6⅝
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —107	104 —107	106½	105½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	...	9/16— 11/16	9/16— 11/16	9/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	5 — 6	5 — 6	5¼	...
3,381	Submarine Cables Trust	Cert.	...	...	...	132 —137	132 —137	135	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½— 4	3½ — 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	95 — 100	95 —100	97¾	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½— 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	101 —104	101 —104	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	94 — 99	94 — 99	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	...	8¾— 9¼	8¾— 9¼	9 1/16	9
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½— 7	6½— 7	...	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	...	2¾— 3¼	2½— 3	2¾	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	...	102 —106	102 —106	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	102 —106	102 —106	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅛%	...	1 — 1¼	1 — 1¼	1⅛	1 1/16
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10¾— 11¼	10¾— 11¼	10 13/16	10¾
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	113 —118	113 —118	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	...	102 —106 xd	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	6¾— 7¼	6¾— 7¼	7 7/16	7
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	6¾— 7¼	7 — 7½	7½	7
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	115 — 118	115 —118	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14 — 15	14 — 15	14⅝	14 3/16
40,000	Do. do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16 — 17	17	16⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8 — 9	8 — 9	...	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	...	10 — 11	10 — 11	10 13/16	10¾
50,000	†Liverpool Electric Supply, all paid	5	5 %	5⅛%	...	7⅞— 8⅛	7¾— 8	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	...	12½— 12⅝	12⅝ - 13⅛	13⅛	12⅝
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	115 —119	116 —119	116¼	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	....	1 %	2 %	8½— 9	8⅜ - 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	9⅜— 10¼	9⅜ - 10⅛	10⅛	9⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½xd	9¼ — 9⅝	9⅜	9½
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9½ — 9¾	9½— 10	9⅞	9½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, March 4th.	Closing Quotation, Mar. 11th.	Business done during week ended Mar. 11th, 1896. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 % §	2½%	...	1⅛— 1⅜	1⅛— 1⅜	1⅝	1⅛
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅛— 1⅜	1⅛— 1⅜	1⅜	1¼
125,000*l*	Do. do. 4½ % Perp. Deb. Stock... ...	Stock	4½%	4½%	...	110 —115 xd	110 —115	...	...
630,000*l*	City and South London Railway	Stock	1 1/16%	1½%	1 5/16%	40 — 42	40 — 42	41⅛	40⅛
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	...	2¼— 2¾	2¼— 2¾	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1½— 2	1½— 1⅝	1⅝	1 7/16
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4 xd	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	103 —106 xd	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1⅛— 1⅜	1⅛— 1⅜	1⅜	1 5/16
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2¼— 2⅝	2¼— 2⅝	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅝— ⅞	⅝— ⅞	11/16	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝— ⅞	⅝— ⅞	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼— ⅜	¼— ⅜	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½— 10½	9½— 10½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	15 — 16	15½ — 16½	16⅛	15⅞
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	16½ — 17½	17½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	107 —112 xd	107 —112	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	19½— 20½	19 — 20	20	19⅜
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	103 —105	103 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅛%	13⅜— 13⅞	13⅜— 14	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾ — 16	15¾ —16	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	38 — 41	39 — 42	41⅜	39½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	5½— 5⅝	6 — 6½	6½	6

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 189
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½% 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6¼.

Electric Construction Corporation, 6 % Debentures, 103—106.

House-to-House Company (£5 paid), 3¼—3½.

Do. do. 7 % Preference, of £5, 7⅞—8⅛.

Do. do. 4½% Debentures of £100, 109—111.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8—8½; 1st Preference Cumulative 6 %, £5 (fully paid), 7¼—7⅜.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼

London Electric Supply Corporation, £5 Ordinary, ⅜—½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6¾—7½.

Bank rate of discount 2 per cent. (February 22nd, 1894).

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

At the ordinary general meeting of the Institution, held at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Thursday evening, February 27th, the chair was occupied by the President, Dr. John Hopkinson, F.R.S.

The names of new candidates having been read, and other formal business transacted,

The Secretary announced that Mr. G. G. Ward had presented to the Institution a beautiful photograph of a picture lately presented to the New York Chamber of Commerce of the projectors of the Atlantic cable.

The discussion on the papers "On Electrical Wiring," by Mr. Sam. Mavor and Mr. F. Bathurst, was then resumed.

*Mr. G. Binswanger said he wished to add a few words to the discussion as to how he viewed this subject as a manufacturer. The question whether this or that system of wiring should be adopted for any particular installation was a question to be decided by the contractor. Manufacturers had to find out what demand there was likely to arise. He came into contact with a good many contractors, and he found a general consensus of opinion that wiring in wood casing must, some day or other, be superseded. It certainly was not a system which recommended itself to the fancy of an engineer or an architect. He had also found amongst contractors an idea that the fire insurance offices, and especially the Phœnix office, recommended, or even insisted upon the adoption of wood casing. He might say that such an idea was erroneous. Mr. Heaphy had passed wood casing because, as he had often told him (the speaker), from his point of view, he had never had a failure—he had never had a fire to record; but if any system could be proposed which gave him the same security—and after all the consideration of fire risk was the first which they had to study—and if such a system should present advantages to the engineer and to the architect, he was sure Mr. Heaphy would be one of the foremost to recommend its adoption. Contractors often asked him the question whether if they adopted any of the new systems proposed, they would be able to obtain the materials required readily, and at reasonable cost. His answer was that, of course, the question of supply depended upon the demand—the larger the demand, the more ready the supply. As to cost, that must depend, and did depend, to his mind, largely upon the contractor himself. If he enabled manufacturers to lay down a plant to manufacture cheaply, no doubt the cost of the material would be low. The material required for wood casing had had an enormous sale for the last 10 years, and naturally the cost of such material was at present very low. To compare, therefore, the cost of installations of the new methods proposed with that of the old methods, was, to his mind, unfair to the new methods. Some previous speakers had tried to do so. He could predict confidently, he believed, that if any of the new systems proposed had only one-tenth part the run of the old wood casing, the cost of an installation by either conduit or concentric methods as regards labour and material would compare favourably. There was another question which also referred to the matter of cost, and which again, to his mind, was in the hands of the contractor and the consulting engineer. That was the question of standardising. Let them, at the very beginning of a new system, fix on a standard, so that every contractor should use nothing else, and use as few parts in the installation as they could. The question of the size of the wire, especially the insulation of the wire, the question whether one or two wires should be put into a tube, the size of the tubing, the pitch of the screws, the many different accessories, all these should be standardised by competent authority, and every contractor should use nothing else. What struck him most in Mr. Mavor's very excellent paper—he did not refer to his rather unkind remarks regarding crockeryware—was his successful attempt at standardising. The same might be said of Mr. Bathurst's system, which also lent itself very much to being standardised from beginning to end. It was rather superfluous in that room to speak about standardising; they all knew how much they suffered from the want of standards in England. Why should manufacturers in England make, for instance, different alternating current motors, alternating meters, alternating arc lamps, simply because so many different periodicities existed in alternating stations? This matter had a great influence on the cost, and at the present moment this question of standardising should be well considered, and he was inclined to suggest that some committee should be appointed by the Institution to give them some standards. He believed every manufacturer in England would be glad to adopt them. No doubt 90 per cent. of the contractors would welcome such action; how many consulting engineers would adopt such standards he would, without consulting them, be hardly prepared to say. He thought that the present time, when important developments were agitating electrical industry, such as motors for transmission of power, electric traction systems, new and higher voltages on our central stations, and to-night, when discussing new systems of wiring,

* Those marked with an asterisk have corrected their remarks.

now was an opportune moment to agitate for the appointment of such a standardising committee.

*Mr. H. Boot said: So far as the discussion had gone, very few speakers seemed to have realised the enormity of the question at issue. They might say, whether central station engineers, manufacturers, or whatever they were, that everything depended upon this one question. It seemed to him important that greater attention should be paid to one or two matters not yet alluded to, such as lowering the cost of point wiring. It often happened that at the same time they were obtaining an estimate for wiring for electric lighting, people got an estimate for fitting with gas; and when the two costs were compared, the difference was simply ridiculous. He knew a cable was far more expensive than iron pipes; at the same time, unless they adopted some system whereby they could reduce everything to the lowest cost, especially for point wiring, he did not think that there was any good in introducing further complicated systems. Low cost for point wiring, durability, damp-proof, elegance, reduction of fire risk, small destruction of premises, were all points which should be considered. What they really required was a system that could be put up by any ironmonger of repute. It was impossible to always keep out what they might be inclined to call jerry wirers. They wanted to see everybody going in for electric light in the same way that everybody goes in for gas, and simplicity of system would tend a great deal in that direction. It was clearly unnecessary to go into the question of the most economical area for cables to the nicety Prof. Ayrton does, using cables more or less of the same size, they would not need to put in so many cut-outs. It was a question very much of labour in wiring costs. If they looked critically at the cost of wiring, they would find it came out that it was carpenters, joiners, and wiremen, that cost the money, and not the actual material. If they reduced this labour and made the matter so simple that any intelligent man could put up an installation, they would be benefiting the electrical industry as a whole. A great number of members seemed to be under the impression that electrical wiring and contracting business should be undertaken only by firms of great repute. This naturally occurred in all cases. Take, for instance, the gas industry. At the start there was only a certain number of people who went in for that kind of work, and it was regarded as imperative that the work of installation should only be carried out by gas engineers. They did not want that sort of thing in electric lighting, as it would hinder its general adoption. In provincial towns, of which he had some experience, it was a very general thing for the householder to have his gas and water put in by a local ironmonger, and they would naturally come to him for electric light wiring. If he did not undertake it, they would give the thing up, and decline to be bothered with it. Cases of that kind were very frequent. The chief point to be remembered was simplicity of design, and unless a system could be brought to light which attained that result, as he was afraid the two before them scarcely did, it was almost unadvisable to make any change. Casing was, no doubt, unsuitable, and he thought the system of the future would be lead-covered conductors buried direct in the plaster, probably using the lead as the return when the Board of Trade allowed it. The tubular system undoubtedly came out dearer, because it had not been generally adopted; but if it were long on the market, it would probably come out cheaper than the present method of wiring. With regard to Mr. Mavor's system, his experience tended to show that the fittings were rather expensive, and required a special class of labour; he was rather surprised, therefore, that Mr. Mavor should claim cheapness for his system. So far as ship lighting was concerned, probably it was cheap, because wood casing was out of the question. For ordinary buildings at the present time, however, he did not consider that it did come out cheaper. If the readers of the papers had given a few more particulars as to how the cost was made up, how much was allowed for labour, how much for holders and various other items, they would have been able to judge better, and compare with the present systems; they would be able to see what they saved by casing, and what the extra cost was for labour. The question of this wiring he hoped would meet with a more definite attempt to arrive at certain standards, as another speaker had suggested, and it is quite time the I.E.E. stopped the present system of every town having a different periodicity, and attempt to standardise everything, so that manufacturers could always tender with equal advantage.

*Mr. W. R. Rawlings said Mr. Bathurst had remarked in the coffee room, "I wish they would tell us whether we are right or wrong." He (the speaker) was not in a position to tell him this one way or the other, but he would like to point out a defect in the tubular system as exhibited by Mr. Bathurst. The tubes themselves were not flexible. The most flexible ones he had were those not covered with metal. It was of no use saying they could do without a flexible tube, because contractors were asked to place wires behind valuable cornices, which they were not allowed to cut, and unless the tube was flexible, it would not answer in that case the purpose for which it was required. An important point, apart from the necessity of its being flexible, was that, where it was buried beneath plaster, it should be nail proof. He (Mr. Rawlings) had had very many nails withdrawn himself, and he was sure if Mr. Mavor had had the experience which he had had of the modern house decorator who form panels with mouldings and nails, he would change his views. Insulation tests did not find nails unless they were in damp places. He had recently withdrawn a nail that had been in circuit for two years, and was then only found by accident. While on the subject of insulation tests, he should like to state that he considered that the unit was somewhat of a myth. They were in the habit of taking per lamp as the unit. If they took as an illustration the case of a small shop fitted, as was very often the case, with 10 pendants, each having six lights, hanging from a flexible cord, each pendant having its own switch, there were then 20 points to bring down the insulation, and in spite of what Prof. Ayrton had said, he contended that it was nothing else but these that brought the insulation down. Then compare this shop with its 60 lights with a house well-fitted with the same number of lamps, with 55 outlets for those lights, and probably 50 switches, making in all 105 points. This, he contended, was very unfair to the contractor, for while he was asked to give a certain insulation per lamp in the one case, he was not asked to do more in the other. Mr. Mavor rightly pointed out the trouble of the labour question. It was, he thought, the duty of the Institution to stamp out the workmen who were going about, the scum of other trades, who called themselves wiremen. He understood that the City and Guilds of London Institute was doing something in this direction; but whatever they might do, if they qualified the men they would not necessarily make them honest, and it was honesty of purpose they wanted in their men. A few weeks ago they had on the table specimens of bad joints supposed to have been put in by a firm of repute. He had not the least doubt that that firm had every reason to believe their installation was put up rightly, for they assumed the honesty of their workmen. He would suggest that the Institution should have a method of registering the men. Let the members support the men so registered, and, if necessary, blackball those who did not come up to the standard of honesty.

*Mr. Dykes said at the present time the question, which was the best system of electric wiring, was on a par with the question which was the best engine or boiler. It simply depended on the circumstances of the case. In fact, practically, every system which had been mentioned could be made good in the proper place. They had heard a good deal in dispraise of wood casing, but he maintained that if proper care was taken, and wood casing was put in the proper place, they could make quite as good a job with it as they could with any other method; but, on the other hand, they must not put wood casing in a building which was obviously not suited for it. He had in his mind at that moment an installation where, he thought, they had a sample of pretty nearly every kind of wiring which had been mentioned. There were certain rooms having a good deal of panelling, and there, naturally, one would put in wood casing to match the woodwork; and if it were properly put in and properly used, he contended it was as safe as any other part of the installation. There were other places where the wires were simply run in iron pipes coated with Angus Smith's composition, those places being conservatories, stables, and so on, where it was important to have the wires thoroughly protected, and where there were no decorations to be studied. In still other parts of the same installation were wires run in compo piping, placed where it was impossible to be damaged by nails. There were places of that kind in all houses. To take one case, walls covered with tapestry, where the only way to get to a bracket position was simply to push a fishing rod up at the back with a wire at the end, and pull it through a hole in the tapestry. It was not likely that anybody would drive a nail through the tapestry, so that it was perfectly safe. The concentric system of Mr. Mavor certainly possessed considerable advantages in cases where it could be used. It was a great advantage that all the trouble which they generally experienced in trying to keep the insulation above earth was done away with. All that one had to consider was the insulation between the positive and negative main. That was an important point, but one which did not call for the notice either of the fire insurance inspector or the supply company. They might have a low insulation resistance on a system of that kind; unless it was low enough to blow the fuses, it did no serious damage. It did not matter what system of wiring they used; it seemed to him the trouble was not in the wire or in the conduit system itself, is was practically always at the accessories, the switches, fuses, and so on. If they made the switches, cut-outs, wall plugs, and so on, good, they could pretty well use any system of wiring they liked, provided, as he had said, they suited the system to the place where it was to be employed. With regard to the use of iron pipes carrying insulated leads, the pipes being uninsulated, they were told by Mr. Bathurst that if they wished to use iron pipes, they must insulate them inside. He (the speaker) maintained that that was entirely wrong. If they were going to use an iron pipe, they should not insulate it at all. If they had leakage from their wires, then let it go direct to earth, blow the fuse, and all would be over. That meant, of course, they must break up their system, and only use comparatively small fuses; in fact, he went so far as to say they should not use anything larger than 3/20 circuits, carrying five or six lights. In the class of buildings which was now becoming so general for insurance offices, banks, public halls, &c., where the flooring was of wood blocks, laid direct on the iron and concrete fireproof floors, and where the walls were faced with marble, tile work, or hard plaster, he was of opinion that the iron pipe system offered advantages over all others. As his firm had had some considerable experience of that system, a few particulars might, perhaps, be of interest. To begin with, they found that it could be put in at a cost not exceeding that of good wood casing in a similar building. The pipes were laid as the work went on, the cement floors being floated over them, thus avoiding the usual cutting away of plaster, floors, &c., and although the pipes might be in position months before they were covered by the floor blocks, tile work, or plaster, no damage was done, and not a single yard of wire had to be replaced through being damaged by workmen. The heavy joiner's bill, too, was of course abolished. There was no trouble in getting a very high insulation, as high as with any other system; it only meant, as usual, that fittings, switchboards, &c., must be well insulated; until these were put up the insulation was practically infinite. As the current was generally switched on in sections as the work was finished, it was often difficult to get a test of the installation as a whole, but he might say that a test at a City bank wired to their specification on this system gave, when tested some weeks ago, and repeated once or twice at intervals, an insulation of 1½ for 135 lights. At a similar installation a section of 40 lights tested the day before gave only the faintest movement on

the ohmmeter, which was calibrated up to 5 Ω. In both these cases the switches were let in flush with the tile work, and in the former case there was a large number of points on glazed brickwork in the cellars. At another installation in a private house tested a week or so ago, where a mixed system was used, the total number of points was 114, there being four distributing boards, and the insulation of the whole above earth was 2·9 Ω. These figures would show that it was not at all impossible to get very high insulation by taking a few precautions, although, at the same time, he personally put very little trust in insulation tests. They had an iron pipe installation of about 430 lights, where all switches were, as usual, sunk in the tile work, hidden by fancy metal covered plates. In this instance switches of the "tumbler" pattern were used, the flat cover plate being screwed on in place of the usual cover. With these plates off, the installation tested out quite as well as the rest; but when the covers touched the tile work, the leakage over the numerous switches was sufficient to bring down the insulation very considerably indeed, although still above the ordinary fire office requirements. They could be remedied, partly, by slipping a piece of mica between the plate and the tile. Their fuse boards, always of marble, as they found slate too unreliable, were carefully insulated on porcelain or ebonite insulators from the iron frame or wooden bearers; if the marble touched the iron at any point, down went the insulation. The ideal system would be, of course, to connect all fittings, electroliers, standards, &c., direct to the iron pipes, but at the present time it was found impossible to get sufficient insulation between the frame and the lamp-holders to allow of this being done, and it was necessary to carefully insulate the fittings from the pipes. One point, in conclusion, seemed to be of importance, the question of gas mains touching the iron pipes. He urged that the iron pipes should be continuously connected throughout, and an efficient connection from the pipes made to earth at one or two points, when it would not matter whether the pipes touched gas or water pipes, or, as was certain to happen, the iron joists of the building. Unless these precautions were taken, it was conceivable that serious consequences might follow.

•Mr. H. Human said, when reading over the papers under discussion, he recognised that the fire office question was bound to crop up, and that he was therefore in for a bad quarter of an hour. Though he would prefer to ignore that part of the subject, he could not deny that it had been very prominent during the discussion, and was so vigorously handled by Major-General Webber, that it was impossible for him to do so. He might say that at the outset, and speaking only for himself, that he agreed with a great deal that had been said anent fire office inspections of electric installations. He admitted that many of those inspections were more or less a farce, and must necessarily be so; he would even venture to say that fully nine out of every ten of such inspections might well be dispensed with, being little else than a waste of valuable time, and wholly unjustified. Indeed, the day must come when the electrical inspector, pure and simple, of the fire office would disappear from the scene, and his rules with him. With regard to fire office forms, again he agreed that some of them were unnecessarily long; they attempted too much. A form is a useful thing in its way, when kept within moderate limits. It serves as a record in the books of the company, and further enables one to judge as to whether there is any special feature calling for further attention. But a few simple questions easily put, and as easily answered, should suffice. Some of those forms are very entertaining reading, and he noticed in particular that contractors have a remarkable affinity for the word infinity when speaking of insulation. Well, he hoped they knew what they were about when using it. There is ample documentary evidence to prove, if needed, that if the Institution recommend that all tests for insulation should show infinity, there would be no difficulty whatever on the part of the contractors in meeting that little requirement. General Webber appears to be very much incensed at the present rating of central stations by the fire offices; but while he (the speaker) could quite understand that gentleman's feelings in the matter, he begged him not to put the whole burden upon the one animal. When those stations first came up for consideration, the fire offices regarded them very favourably, and accepted them at exceedingly low rates. The fire offices have now bought their experience, and paid for it dearly, for, "There stands at present a large deficit against you. There is no sentiment in the matter whatever; it is purely a business transaction. We may not be interested, as you are, in the conservation of energy, but we are very much interested in the conservation of pounds, shillings, and pence. We now recognise that not only have we underated those risks, but have, in consequence, undersold our identity, and, as business men, are simply rectifying that little error by raising our rates." But Gen. Webber objects, apparently, to being tarred with the same brush as his friends. That he (the speaker) could quite understand, and sympathised with him, for it was a process which fire office surveyors too frequently experienced at the hands of engineers when dealing with electrical matters. But in Gen. Webber's case he failed to see how it could be obviated, for it must be remembered that where you legislate for a class, there must be no exemption in favour of individuals. As so often happens in other matters, the good have to pay for the bad. That might be poor consolation for Gen. Webber, but it was the best he could offer him under the circumstances. As to making reductions in favour of electric lighting—particularly in such buildings as dock warehouses—he would remind Gen. Webber that the lighting was by no means the one and only thing to be feared, but that the risk in such places was inherent in the varied nature of their contents, and to allow for electric lighting in those risks would indeed be straining at a gnat and swallowing a camel.

•Mr. J. N. Shoolbred said, although there were many points in the papers which had impressed him, he would confine his remarks to one particular point, and that was with regard to the table of insulation tests which Mr. Bathurst had put in his appendix B. In the first place, he was very glad to see that in that table Mr. Bathurst had adopted the ampere as the basis for the test, and not the lamp, as was commonly the case with several of the various sets of rules we had in use in this country. There was great confusion in regard to the lamp, for some people imagined it was an 8 C.P., and others a 16 C.P. Then, again, arc lamps had to be considered. But it is when motors, and other similar applications are introduced, that it becomes evident that the "ampere" *must* form the basis of the test, and not the "lamp." At the present moment there was the question of raising the voltage, and that, again, would diminish the ampereage and add to the confusion. Decidedly the lamp was not the thing to be adopted, but, as stated in this table, the quantity of current should be the basis of the test. They should also, to a certain extent, take into consideration the question of voltage. In confirmation of what he had said, he might mention that in 1889 he was discussing with Major Cardew some of the rules for wiring which were proposed by the Corporation of Bradford, and the Corporation were afterwards only too glad to adopt a very important suggestion of Major Cardew's, and that was framed in their regulations, and has been at work ever since, and there had been no trouble with it; no complaints had been received on the subject, and the several contractors engaged on the wiring all said that some such basis should be universally adopted. That clause provides that the result of the test shall not be less than the number of ohms indicated by the number resulting from the division of 10 millions (*i.e.*, 10 megohms) by the number which expresses the maximum electric current in amperes which has been applied for by the consumer. Respecting "the maximum amount of current named by the consumer," Major Cardew laid some stress upon this; as the Board of Trade distinctly state that the consumers are to make their application in terms of the current required. He, himself, had formed a comparative table of some of the various tests which were in use; and this he would append to his remarks, as the table might prove both instructive and interesting.

(To be continued.)

High Voltage Lamps, and their Influence on Central Station Practice. By G. L. Addenbrooke, Member. Paper read February 27th, 1896.

In the spring of 1891, which was the last occasion when the Alternating *v.* Continuous Current controversy came prominently before this Institution, and when Mr. Crompton brought forward his feeder argument, I had the honour of opening the discussion, and subsequently continued the argument in the technical Press, besides going into it privately with Mr. Crompton.

I was not, however, convinced of the superiority of *low pressure* direct supply, and on the old premises I remain unconvinced still; but I saw that the advantages of the two systems were in many cases very nearly balanced, and if one or other was ultimately to prevail, it would probably be for some other reason than lay in the arguments which had so far been brought prominently forward on either side.

It was, in my mind, useless to say that the two systems were each the best for certain situations; for how was the line to be drawn? or, in some cases, were we to have both systems in one town? Though a possible, this did not seem to me a desirable solution.

The question is not merely an academic one; hundreds of thousands of pounds are every year now spent on electric lighting, and that a large portion of this sum should be spent in a way that is not the best and most permanent is a serious matter.

Besides this, as a consulting engineer, I found my position an unpleasant one. What was I to recommend to my clients? and if I halted between two opinions, what would my clients think of me? I regret that in these matters I have not the assurance of some gentlemen who, I understand, circularise all town councils, keep their own touts, and are prepared to give cut and dried verdicts without hesitation on engineering points which, I must confess, I approach with a certain amount of awe and misgiving, and a very serious sense of responsibility.

Now, it struck me four years ago, as I daresay it did others, that, as the two methods had been argued over so carefully without any definite conclusion being arrived at, probably some outside and fortuitous circumstance which neither side had taken account of would ultimately turn the balance one way or the other.

Possible Sources of Influence on Central Station Practice.

I therefore made a careful survey of the field, and the only eventualities I could think of, or which seemed likely to have a very important bearing on the problem, were the following, viz.:—the introduction of—

1. An altogether new form of lamp.
2. A cheaper material for mains than copper.
3. A high-voltage incandescent lamp.
4. A much more economical incandescent lamp of the present voltage.
5. An improved and much cheaper storage battery.

Respecting a new form of lamp: After having seen Tesla's experiments at the Royal Institution, and after having learnt privately the views of some of our leading investigators on the field which they opened, I must say, as a practical man, I did not see any immediate hope of commercial success in this direction, however interesting the results might be scientifically.

As regards the chance of a cheaper conductor being forthcoming, I have dealt with this question at length in a recent article in the Electrical Review.

Owing to the cheap rate at which aluminium can be produced, and will increasingly be produced in the future, and since the conductivity of aluminium is 56 per cent. that of pure copper of the same section, the chances of aluminium ultimately supplanting copper are strong, but the change will undoubtedly be a comparatively slow one. The

possibility of this, however, points to a reduction in the price of conductors; and this, of course, would tell somewhat in favour of moderate pressures.

Again, as even in moderate-pressure mains insulated with bitumen or other compounds the cost of insulating is twice the cost of the conductor itself, in the sizes usually employed, it is quite conceivable that very important economies may be effected in this direction. It is obvious that improvements of this character would probably tell more in favour of moderate pressure than of high.

Having thus disposed of the conductor question, we come to the third and fourth alternatives I have mentioned as likely to influence central station practice, viz., the introduction of a lamp of higher voltage, or a more economical lamp of the present current voltage.

When thinking over the matter in 1891, I saw that, as fairly good lamps of 8 candle-power for 100-volt and 110-volt circuits were being made, two of them could be put in series, and that we should get very simply a 16-C.P. lamp of 200 to 220 volts. This, however, involved giving up 8-candle lamps, except two in series, which, as the charge for current was then usually 8d. per unit, was a serious matter, and again, as there were two filaments in each lamp, the breaking of either of which would spoil the lamp, this also introduced an important objection, particularly as the Ediswan monopoly maintained the price of lamps at 3s. 6d. for ordinary voltages, and could hardly be expected to supply lamps which would be more expensive to make, except at an enhanced price. The prospect of obtaining high voltage lamps did not, therefore, at that time appear bright.

Time has, however, brought about great changes in the lamp industry, due largely to the expiry of patents, which quickly led to numbers of good lamps being placed on the market at less than one-third the price formerly charged, and at the same time brought active and pushing competitors into the field.

Two years and a half ago, finding some disposition abroad to adopt higher voltages, I drafted an article pointing out the enormous gain which would accrue in the distributing system if higher voltage lamps were adopted, intending to send it to one of the journals. The question, however, then appeared somewhat problematical, and other business led to the article being put on one side. I did not, however, forget the matter, and last December year, finding that one or two firms were trying to introduce lamps of 200 volts, I looked over my draft again, and having somewhat elaborated it, sent it to the Electrical Review. The article attracted the attention of Mr. Baynes, then of Bradford, and he wrote detailing his experience, and the experiments he had made with high voltage. Since then the matter has advanced by leaps and bounds. Several lamp makers are undertaking to supply 16-C.P. lamps of voltages up to 230, and even above; and not only this, but Mr. Stearn, and one or two other makers, are offering lamps up to this voltage of 8 C.P. also, and guaranteeing a fair economy. The lamps are also being offered at moderate prices.

Low tension central station engineers have not been slow to perceive the facilities these lamps offer. In some cases they have been adopted publicly, and in other cases private experiments are being made on them, with satisfactory results. I also hear from those manufacturers who are catering for the market that the demand for high voltage lamps is steadily and rapidly increasing.

The adoption of these lamps is, of course, somewhat in the tentative stage; but so much progress has been made, and the results attained so far are so good, that no one can doubt that in a year or two they will become a permanent institution.

It may also be noted here that since this paper was sent in I see that Prof. Kennedy has considered the 230-volt lamp sufficiently sound to recommend the Town Council of Edinburgh to adopt it.

Concurrently with this development there has been a tendency towards the use of lamps of ordinary voltage, but of higher efficiency, and I must say that until recently I have been unable to quite make up my mind which was the best of the two lines to work on—whether it would be better to use lamps of 100 voltage, and taking 2½ watts per C.P., or lamps taking 4 watts per C.P. with a voltage of 200 or 220. I think, however, the matter now admits of being argued out pretty clearly.

By a reduction of current per C.P. in the proportion of 2½ to 4, mains of a given capacity would do nearly double the amount of lighting with the same expenditure of energy.

Energy in itself is very cheap, however, and any fair-sized central station could supply double the quantity of energy it is now doing at 1½d. per unit for the extra current, if this did not entail extra expense for mains.

Now, by doubling the voltage, we reduce the size of the mains to one-fourth, other things being equal; consequently the mains for a station using 220-volt lamps consuming 64 to 70 watts per 16 C.P. lamp, to give the same percentage loss, would not be much more than half the size they would be if the station supplied 110-volt lamps consuming 2½ watts per C.P., as the current would be nearly the same in both cases.

As the cost of mains is such a very large proportion of the whole central station cost, and as energy can be generated so cheaply, I am fairly confident that, even if a good 2½-watt lamp were obtainable, it would pay better to use 220-volt lamps taking nearly double the current.

Conversations with lamp makers, and recent publications on the subject, have convinced me that a good 2½-watt lamp of 100 volts has yet to be attained, and will probably be a very difficult thing to achieve, unless absolutely even pressures in the mains can be guaranteed. The opinion of lamp makers appears universally to be that a 220-volt lamp at 3½ to 4 watts per C.P. is a more practicable and attainable object than a 100-volt lamp at 2½ watts. They seem also unanimous that if a good 2½-watt 100-volt lamp could be made, a good lamp of 220 volts, and of better efficiency than 4 watts, would be forthcoming.

It therefore appears that by taking a 220 volt lamp now we shall get all the advantages of high voltage, and in time shall get nearly as efficient a lamp as if a lower voltage were used, while the high-efficiency lamp is even now in a far less forward state of development than the high-voltage lamp.

Consequently, it seems clear that the high-voltage lamp is the better line of the two at present.

Besides this, we are anxious to cheapen the cost of current so that it may also be available for power purposes, and thus small economies in consumption will be of less and less moment.

It is, therefore, obvious that not only in the present, but for the future, the high voltage lamp is likely to be the better, and that it is safe to run the risk of being unable to use very economical lamps, provided decent ones of high voltage can be obtained.

As I thought it would give a practical basis to this paper, and would be of interest to members to see specimens of some of the various high voltage lamps which are being made, I have written to leading makers on the subject, and through their kindness am able to submit a number of 220 volt lamps, concerning which I will now give the particulars supplied by the makers.

Lamps to be arranged to burn.

Present data from makers, &c.

I shall not pursue this branch of my subject further, as it would be more suitably dealt with by a lamp manufacturer in a special paper; but I think enough has been said, coupled with the knowledge members already have of the subject, to show that high voltage lamps are thoroughly practical for central station work, and I therefore pass on to consider how far it is desirable to use them, and what effects they are likely to have on central station practice; this being more immediately the subject of my paper.

Life of High Voltage Lamps

We can, of course, hardly expect the life of these high voltage lamps to be as long as that of lamps of half the voltage, while at the same time they will be rather more expensive, consequently there will be a greater expenditure for lamp renewals when they are used; and it is advisable, I think, to try and arrive at a figure for this before proceeding further.

If the life of an ordinary 16 C.P. lamp of 100 volts is 1,200 hours, and it consumes 64 watts, during its life it will consume 77 B.T. units, which, at 6d. per unit, amounts to 38s. 6d. If the cost of the lamp is 1s. 3d., its cost per unit of current consumed is 0·2d., or ⅕d. or about 3 per cent. of the cost of the current.

For an 8-candle-lamp of 100 volts, lasting 800 hours and taking 36 watts, the consumption of current is 29 units; and at the same price for lamps, the lamp cost per unit of current consumed is about 0·5d., or ½d., or about 8 per cent. of the cost of the current.

I have assumed the above life for these lamps because I think, after burning the number of hours indicated above, most lamps would be best thrown away; though I am perfectly aware lamps often last twice as long as I have assumed, and they can also be purchased for 20 per cent. less from reliable makers.

200 or 220-volt lamps will, of course, cost rather more, and their life would be rather less, but I believe I am putting the case more adversely for the higher voltage lamps than is really true, in taking the cost as double the above rates for lamp renewals where high voltage lamps are used.

The cost of lamp renewals would then be 6 per cent. of a customer's bill if the current was 6d. per unit for 16 C.P. lamps, and 16 per cent. if 8 C.P. lamps were used.

Supposing the number of 16 C.P. lamps installed to 8-candle-lamps is about as 1 : 2—which is, I think, about a fair average—an all-round reduction of 6 per cent. in the charge per unit of current would cover the *additional* cost of lamps, if lamps of high voltage were used; at 6d. per unit for current this is about one-third of a penny per B.T. unit.

Such figures as these can only be approximate, but I think you will agree that they would not be far out in practice, and may be improved upon, and also that they make it clearly manifest that the extra cost of using high voltage lamps offers no appreciable bar to their introduction, providing that their other countervailing advantages are in excess, with which branch of the subject I will now deal.

Effect of using High Voltage Lamps on Distribution.

On this point I do not think I can do better, as a commencement, than quote from my article in the Electrical Review of January 11th, 1895:—

"How great a gain there is in distributing current at a higher voltage, and how much it simplifies the distributing problem, is not at first sight fully apparent, though everyone recognises that there are advantages. The advantages may really be said to progress as the cube of the voltage up to, say, about 200 volts. For let us suppose we have a station on all of whose circuits the lamps require 200 volts to incandesce them, instead of the usual 100 volts. In the first place, having doubled the pressure, we may extend our mains double the distance at the same current density, with the same percentage loss; but at the higher voltage the same current density in a given sized main will give us twice the energy, and light twice the number of lamps. Consequently, without increasing the sectional area of the mains, we can do four times the lighting with the same mains, or the same amount of lighting at four times the distance with the same percentage loss. Then there is a further gain, for, since we can extend the mains four times as far from the central station with the same percentage loss, the area which can be served from a single station is 16 times greater at the higher pressure than at the lower.

"Presuming, however, that this argument is not pushed to its extreme limits, it is well within the mark to say that at 200 volts nine or ten times the area could be better served on the three-wire system from a single station than is now the case at 100 volts; not only is this the case with the feeders, but it extends in an even greater degree to the distributing system. At present there is no doubt that there is an inconvenient fall of voltage in the distributing mains, and

the internal wiring of houses, which leads to irregular and unsatisfactory lighting, and which is under existing circumstances, whatever system is employed, exceedingly difficult to remedy. If by any means the voltage could be increased to 200 volts this would practically vanish, distributing mains might be carried three times their present distance from the feeding point, and the fall of potential in houses would be merely nominal on the present basis of wiring, instead of frequently amounting to 1-2 volts or more. By these means the number of feeding points in a given area would, of course, be much reduced. The same fittings and wiring as are now used would be applicable, and the voltage does not go beyond the Board of Trade limits."

This was a general statement, made largely with a view to point out to manufacturers what a field it would open if they could produce a commercially satisfactory high voltage lamp.

During the last 18 months manufacturers have seen the advantage of exploiting this field, with results which have already been detailed above. Consequently it is desirable to look a little more closely at the distribution problem under its new aspect, and I will therefore ask your particular attention to the figures which I now propose to lay before you.

It is generally acknowledged that in the three-wire system at 110 volts, it is not economical or very practical to distribute current at a radius of much more than three-quarters of a mile from the central station, except under special circumstances. The area which can therefore be economically served from such a station is about one and a half miles each way, or about two and a quarter square miles.

In his well-known feeder paper, Mr. Crompton gave figures which he argued showed that a feeder on the three-wire system, supplying 110-volt lamps, could be laid and maintained, and would involve the same loss of energy, taken over the same day, as would an alternating feeder, including transformers, instruments, and switching gear, the length of the feeders in each case being 2,400 yards.

These figures were strongly attacked by the alternating party, myself amongst the number; the most legitimate point of attack being that Mr. Crompton had assumed a loss of 30 per cent. at full load on the low pressure feeder, which was considered excessive, on account of the extra plant it would entail at the central station.

Had Mr. Crompton put the length of his feeder at about 1,400 yards, or a little over three-quarters of a mile, and had he used a density of about 500 amperes per square inch—which is about the practical density—the loss would have been 16 per cent. for the continuous current feeder at full load, and few alternating men would have seriously combatted that on the whole the continuous current feeder was as economical and desirable as an alternating feeder. The figures would then agree with the generally current comparison which I have mentioned above, and which I propose to use as a basis of argument in order to avoid disputes.

Now, from data I have collected, it appears that in such places as the centre of large towns there are, perhaps, 30,000 inhabitants per square mile, though ordinarily the population for a square mile of a town does not appear to exceed 16,000.

A low pressure station on the three-wire system with 110-volt lamps can therefore serve economically about 60,000 to 70,000 people in the centre of large towns, and about 35,000 in districts outside the centres and in provincial towns. If, therefore, we wished to light London, with its 4,000,000 population, on this basis, taking the average population at 25,000 per square mile, we should need, roughly, 70 to 80 stations to light the whole metropolis, not counting the extreme suburbs.

If, however, in the direct supply system the voltage is double, the position is altogether altered, and a comparison between the transformer and direct supply systems under these circumstances will lead to very different results from those so far given.

Theoretically, if 220-volt lamps are used, we can extend the feeders four times as far as if 110-volt lamps are employed, and therefore the area which could be lighted from each station is 16 times as large. I do not intend to take full advantage of this facility in the calculations which I propose to lay before you, as I consider that the fall of voltage is too large in low pressure central stations at present, and that the voltage of the lamps at different points of the distributing system is not kept as near the normal as it should be. In what I am about to say I shall therefore consider that, instead of four times, we extend our feeders a little over three times as far as before, thus securing better regulation and a smaller percentage drop in both the feeders and distributing system, together with the great saving in copper. If, then, we can extend the lighting radius three-quarters of a mile from a low pressure direct supply station with 110-volt lamps, we can extend it on the above basis, $2\frac{1}{2}$ miles at 220 volts, which means that we can cover an area of 5×5, or nearly 25 square miles from one station—that is, 11 times the area we could before. Instead, therefore, of serving 60,000 people in the central districts, one central station would serve 700,000, and over a quarter of a million in the less central districts. Taking, then, the population of London as 4,000,000 without extreme suburbs, about six or seven stations would comfortably cover the whole area. Now, this is a number which is directly comparable with the number of stations at present being operated by the gas companies; and to my mind it is doubtful if it would be desirable to reduce the number of stations below this figure for so large an area, even if it could be managed.

It would be interesting to go into this metropolitan lighting problem further did time permit, but it does not, and I must ask you now to turn your attention to the provinces.

Take maps of Birmingham, Liverpool, Glasgow, and Manchester, and cut out a piece of tracing paper to represent 25 square miles on the same scale as the map. Lay the tracing paper over these maps, and you will find that two stations, or at most three, will cover not only the whole of these great cities, but the suburbs for a couple of miles outside.

For the general run of large towns one station would amply suffice; and for the smaller ones one station would, of course, permit of lighting over the whole area at a very small expense for mains.

Before a technical audience like this, however, it will doubtless be more satisfactory to investigate a particular instance than to proceed further with general statements.

At 220 volts pressure an ampere represents 220 watts; therefore $\frac{1}{3}$ ampere represents 73·3 watts. Now, at 4 watts per C.P. a 16 C.P. lamp takes $16 \times 4 = 64$ watts, and an 8 C.P. lamp 32 watts.

We shall, therefore, be sufficiently near for the purposes of this calculation, and shall be allowing a sufficient margin, if we assume that a 16-candle-lamp takes $\frac{1}{3}$ ampere, and an 8-candle-lamp $\frac{1}{6}$ ampere at 220 volts.

Next consider the distributive system. There are two points needing attention: the first is, How far, and over what area, can we spread our network from the feeder points? The second is, What drop should we allow on the feeders themselves?

(To be continued.)

Physical Society.

Ordinary Meeting, February 28th, 1896.

Prof. John Perry, Vice-President, in the chair.

Sir D. Salomons showed some experiments with incandescent lamps. A large electro-magnet is excited by means of a continuous current, while an alternating current is passed through an incandescent lamp. On bringing the lamp near the magnet the filament is set in vibration, which, if the lamp is brought sufficiently near the magnet, are sufficiently intense to break the filament. The number and position of the nodes formed in the vibrating filament are found to be independent of the natural period of the filament, but depend on the frequency of the alternating current.

Prof. S. P. Thompson asked whether it was not found that the number of segments into which the filament is divided depended to some extent on the natural period of the filament?

Prof. Ayrton said that the magnetic leakage was very large with the arrangement adopted, and he would like to know whether this method was a more sensitive one for mapping out the field than those ordinarily employed. In an instrument designed by Prof. Perry and himself, an alternating current was passed through a wire stretched between the poles of a magnet, and the tension of the wire was altered till the vibrations set up were a maximum. The natural period of the wire, and hence the frequency of the alternating current, was then deduced from the tension, &c. In Prof. Ewing's magnetic curve tracer, on the other hand, the natural period of the stretched wire was made as different as possible from the period of the alternations which were to be observed, so that the natural vibrations of the wire did not influence the results. The author's arrangement appeared to him (Prof. Ayrton) to be intermediate between these two, and it would seem that the natural period of the filament would to a certain extent influence the results.

Prof. Perry suggested that the lamp might be held in a very steady support, so that after the large vibrations due to the natural period of the filament had died out, the vibrations of the period of the alternations alone could be observed.

Sir D. Salomons, in his reply, said that the arrangement was not intended for making *measurements*. A lamp had been fixed in a steady clamp, and the current passed for many hours, but the character of the vibrations remained unaltered. He had found the vibrating filament useful for microscope work, where a surface rather than a line of light was required.

Prof. Fleming read a paper by himself and Mr. Petavel, on An Analytical Study of the Alternating Current Arc.

The first part of the paper consists of an analytical study of the distribution of light throughout the various radiating regions in the arc, when supplied with electric power of known constant amount, the periodic variations of the current through the arc, and of the potential difference between the carbons being at the same time recorded. The power was measured by means of a bifilar wattmeter, while by means of a series of mirrors, and a rotating disc carried by a synchronising alternate current motor, the mean value of the light taken from any part of the arc was compared with the instantaneous value of the light taken from the same part of the arc, and taken at any assigned instant during the period. Thus the arc itself was its own standard, and difficulties due to slow variations in the mean light of the arc disappear. The facts observed may be summed up as follows:—The purple light of the true arc undergoes a periodic variation, and, as far as the eye can judge, is completely extinguished during a certain interval during the phase; it has equal maxima values during the period, at instants slightly lagging behind the instants of maximum power expenditure in the arc. On the other hand, the illuminative power of the carbon crater varies between a minimum value and two unequal maxima; the greater maximum occurring when the carbon is positive, and an instant slightly lagging behind the instant of maximum power expenditure in the arc. The second part of the paper consists of a comparison of the efficiency of the alternate current arc regarded as a light giving agent, as compared with that of a continuous current arc taking the same mean power. Using two arcs which may be regarded as typical of those used in practice, the mean spherical candle-power was compared for equal expenditure of power in the arcs; and it was found that for the alternating current arc employed, the total mean spherical candle-power was always less than that of the continuous current arc. Lowering the frequency seems to decrease the efficiency of the alternating current arc.

Prof. Ayrton said the behaviour of the alternate current arc was of great interest, for the power supplied could not be measured by simply multiplying the current by the electromotive force, since the current lags behind the volts. The resistance, *i.e.*, the ratio of the current to the E.M.F., also lags, but the anthors do not appear to have made any attempt to measure the *true* resistance. The authors were to be congratulated on the guarded tone they had adopted as to the bearing of these experiments on the question of the relative efficiency of the alternating and continuous current arcs. In a previous communication one of the authors had stated that the alternating current arc must necessarily be a less efficient light producing agent than the continuous current arc. Although the last set of curves given in the paper might appear to support this supposition, he (Prof. Ayrton) felt that the difference obtained was probably due to the fact that the alternating current arc was not being worked under proper conditions. The quality of the carbons and the length of the arc have a most important influence on the efficiency of an arc. At present, our knowledge is not sufficient to allow of our stating definitely whether or not an alternating current arc can be made as efficient as a direct current arc, but there is no doubt that it will be possible to get much better results than are at present attainable.

Prof. S. P. Thompson said that when the fact of the existence of the difference in phase between the current and volts in an alternating arc was first published, he had made some experiments which showed that there was a lag and not a lead, *i.e.*, that the arc acted as if it possessed self-induction. The resistance also lagged, and he thought this lag might be due to a thermal lag. The temperature of the arc will lag behind the current, both when it is increasing and when it is decreasing, and if the resistance of the arc depends on the temperature of the vapour in the arc, then the resistance would also lag behind the current. It was not possible from *à priori* reasoning to say whether or no an alternating current arc would ever be obtained of an efficiency equal to that of the direct current arc. With suitable carbons, length of arc, current and volts, it seemed to him that it might be possible to obtain an equal efficiency. The light giving process in an arc is not merely an irreversible degredation of electric energy into heat, for the difference of potential between the carbons may be written $v = a + b\,l$, where a may be regarded as a back electromotive force, and $b\,l$ as a true resistance. The first term of this expression does not vary with the length of the arc (l), but the second term does. Multiplying through by the current (c), the equation v = watts expended = $c\,a + c\,b\,l$ is obtained. It is the first of the terms on the right-hand side which is a reversible effect, and corresponds to the power expended in driving the current against a back electromotive force, on which the light given out chiefly depends, due to something occurring at the crater surface.

Mr. Blakesley asked whether Prof. Thompson's idea of the light being due to the reversible part of the process was not a strong argument in favour of the direct current arc.

Prof. Ayrton said that in two communications made to the Congress held at Chicago, it was shown that even with direct current arcs there was a certain length of arc for which the efficiency was a maximum. Mrs. Ayrton had quite recently found that the efficiency of arc lamp carbons altered with time. Prof. Thompson's suggestion as to a thermal lag was a valuable one.

Prof. Fleming, in his reply, said that when comparing two agents where there were so many variables, it was practically necessary to restrict the investigation. In their case they had kept the mean power constant, and had left the other variables to take care of themselves.

The Society then adjourned till March 13th.

AUSTRALIAN ELECTRICAL NEWS.

[FROM OUR SPECIAL CORRESPONDENT.]

The N.S.W. Government having decided to instal electric light in the Agricultural College, tenders were called for and the following received. The installation comprises 13 25-C.P. lamps, 182 16-C.P., and 116 8-C.P. lamps. The whole of the work to be in accordance with the rules of the Phœnix Fire Office. In the specification it is stated that provision is to be made in the tender for a sum of £600 for the purchase and delivery of engine, boiler, dynamo, piping, &c. The whole of the machinery will be selected by the Government Architect, who also reserves to himself the right to select the whole or any part of the plant where he determines and not necessarily with reference to the contractor. Under those circumstances it seems hardly worth while including the machinery in the tender. Following are amounts of tenders received:—R. W. Thompson, £1,157; Chas. Highland, £1,182; Milne Bros., £1,198; Edge & Edge, £1,265; Brush Electrical Engineering Company, £1,350; H. H. Kingsbury and Co., £1,395; Chas. J. Otte, £1,486; Morris Bros., £1,554; Gibson, Battle & Co., £1,733. Deducting the £600 for machinery it will be seen that the lowest tender is less than half the highest. The buildings cover a considerable area and are scattered.

In connection with the Tamworth water supply now being considered by the Public Works Committee, Mr. E. B. Price, Assistant Engineer of Public Works, proposes a scheme by which water-power may be available for the electric lighting of the town. He stated before the Committee that he had suggested a gravitation in preference to the pumping scheme, and on exploring the country round Tamworth he found a splendid supply from some high falls in the Moore Creek, which rises in the Moonbi Mountains. There was an admirable site for a concrete dam at the head of the falls, and above the dam site the bed of the creek was level and well suited for a storage reservoir. The catchment area was 23½ miles, which was four times as large as was necessary, and the present flow in the creek after one of the driest seasons known was 70,000 gallons per day. He had provided for a supply of not less than 300,000 gallons per day. There would be a large surplus, which would be available for a supply of power to the electric light plant. The alteration of the creek at the site of the dam was 100 feet above the Tamworth railway station, and the length of the pipe line to the service reservoir would be 12¼ miles. The cost is estimated at £30,000.

A similar scheme is proposed for Walhalla, a mining township in Gippoland, Victoria, which is at present being considered by the Minister for Mines. It is proposed to dam up the Thomson and Aberfeldy rivers, the weir would be 110 feet high, the reservoir thus formed holding over 400,000,000 gallons. The position of the weir is about 2½ miles from the township.

Several of the Tasmanian gold mines have recognised the advantages of electricity, especially when derived from otherwise waste water power. At Beconsfield Messrs. Siemens Bros. have installed a 5½-unit dynamo driven by a Pelton wheel running at 1,500 revolutions, supplying current for two 10-ampere arc lamps and about 100 incandescent of 8 and 16 C.P.

At the Volunteer Gold Mine, Lefroy, Mr. Rowley has put in a small Siemens dynamo, 110 volts 25 amperes, driven by a 6 H.P. Tangye engine, supplying current for about 50 incandescent lamps for lighting the mine; and at the West Volunteer Mine a 30 ampere machine driven by a Westinghouse engine. A 50 ampere 110 volt Siemens machine driven by a Tangye engine, horizontal colonial pattern, 8 inches and 10 inches stroke, has also been put in the buildihgs of the Fresh Food and Ice Storage Company, of Melbourne. An extension of the Military Road electric tramway at North Shore from the Military Road to Mosman's Bay Ferry is soon to be put in hand. The line will be about a mile and a half in length, the total cost being estimated at £8,900, of which £5,000 will be for permanent way and line construction, and the remainder for power, cars, &c. The overhead system is to be adopted, and some fairly steep grades will be encountered, in fact the line will be practically one steady rise from the ferry to the Military Road. The Railway Commissioners have expressed their opinion that the line will be a serviceable and paying one.

THE SIEMENS-HALSKE CYANIDE PROCESS.

We have already made remarks on a paragraph alluding to the Siemens-Halske cyanide process. We must again express our diffidence and incredulity about the contents of the following leaderette which appeared in the *Engineering and Mining Journal* (February 22nd, 1896, page 177):—"We hear by special cable that the Metropolitan Gold Mining Company in the Transvaal have decided to abandon the Siemens-Halske electro-cyanide gold extracting process. A fortnight ago it was announced in the London papers that the George Goch had come to a similar decision, so that it is evident that the process has not succeeded in actual practice. The inventors of this process claimed as their most important point that they could employ much more dilute solutions than the MacArthur-Forrest process; but this argument appears to have been used to make a virtue of necessity, for, unless an extremely dilute solution is used, the rate of destruction of cyanide by the electric current makes the process too expensive. With the extremely dilute solutions used at the Metropolitan the extraction has not averaged over 55 per cent. as compared with the MacArthur-Forrest's average of 70 to 80 per cent. In all probability we shall receive a detailed discussion of the results of the process at an early date."

Our esteemed contemporary so well informed about metallurgical matters, must have been misled in drawing unfavourable conclusions on the electrolytic process. What does it matter if 1, 2, or 3 lbs. more of cyanide of potassium are spent in the electrolytic tanks than in the zinc depositing boxes, if more gold is recovered, and if this gold is purer? On what is based this statement that the destruction of cyanide of potassium by the electric current makes the process too expensive?

We are quite prepared to discuss the matter when more details are to hand; but, in the meantime, we cannot accept such a condemnation of the process, which contrasts so much with the official report of the Rand Central Ore Reduction Company and commented by us in the Electrical Review (November 22nd, 1893).

The following is an extract of the last report of the Rand Central Ore Reduction Company:—

"Plants now Using the Siemens Process.

Name.	Capacity.	Average per month.
Worcester	3,000 tons	700 oz.
Metropolitan	4,500 "	600 "
May Consolidated	6,000 "	1,000 "
Crœsus Gold Mining Company	6,000 "	500 "
No. 4 Central Works	5,000 "	800 "
Robinson Slime Plant ...	8,000 "	

"The test of any process is its ability to precipitate the very dilute cyanide solutions obtained in the treatment of slimes. Successful slime treatment to-day is only possible by means of the use of the Siemens process to precipitate the gold from the dilute liquors without the loss of cyanide. Absolute precipitation of the gold contained is merely a question of the right box capacity to give sufficient circulation to the solution and expose it long enough to the action of the current. Experience gives the following result:—

"We find that with a box inside 30 feet long, 4 feet 7½ inches wide, and 9 feet high, containing 121 plates of steel, 4 feet 6 inches × 8 feet × $\frac{3}{16}$ inch as anodes, and having as cathodes 120 frames containing

4 sheets of lead each 4 feet × 2 feet, 480 sheets containing 8 square feet each = 480 × 8 = 3,840 square feet lead, each plate = 22 ozs. we can precipitate 50 tons solution per day from 2 dwts. of gold to a trace only per ton." . . . . . .

"*No. 6 Works (Worcester).*—These works, where the Siemens process was at first introduced, are under the immediate direction of our able assistant-manager, Mr. A. Van Gernet, late of Siemens & Halske. These works have the credit of making an ounce of gold at the lowest cost of any of our plants. They have continued to be a constant source of experience to us, and have made, at the same time, a handsome profit—which cannot always be said of the first plant built to exploit a new process.

"*No. 7 Works (Metropolitan).*—The Metropolitan plant made a record cost for treatment with the Siemens process for the month of July—2s. 5d. per ton—being, next to the May Consolidated (also the Siemens process), the lowest cost for treatment yet obtained by the cyanide process."

Our contract ceases with the Metropolitan Company on November 1st, 1895. The contract has been a profitable one to both companies.

The last words: Our contract *ceases* with the Metropolitan on November 1st, 1895, may explain, quite naturally, the cause of the decision taken by the Metropolitan Company. Under any circumstances, we should support the electro-deposition of gold against its deposition by zinc.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 31, *High Holborn, London, W.C., to whom all inquiries should be addressed. Copies of any of the specifications may be obtained of* Messrs. W. P. Thompson & Co., *price, post free*, 8½*d. (in stamps.)*]

NEW PATENTS.—1896.

4,174. "Improvements in the method of fixing caps to incandescent electric lamps, and in joining the leading-in wires of such lamps to contact plates." J. A. Sinclair. Dated February 25th.

4,175. "(The sparkless) switch." J. A. Fisher. Dated February 25th.

4,179. "Improvements in electric road vehicles actuated by electricity." T. Machin. Dated February 25th.

4,207. "Improvements in instruments for measuring electric currents." W. Thomson (Baron Kelvin). Dated February 25th.

4,222. "An improved globe or incandescent burner for tramway, omnibus, and various lighting purposes." W. A. Perry. Dated February 25th.

4,234. "Improvements in electric lamps for vehicles." J. Zimmerman. Dated February 25th.

4,237. "Improvements in continuous current electric motors and method of regulating the same." J. Devonshire. (Elihu Thomson, United States.) Dated February 25th.

4,238. "Improvements in windings for armatures of dynamo-electric machines and motors." J. Devonshire. (W. H. Knight, United States.) Dated February 25th.

4,345. "Improvements in the production of gas by means of electricity." J. H. Dunn and R. G. E. Dalrymple. Dated February 26th.

4,369. "Improvements in wooden casings or mouldings for electric conduit wires and cables." C. J. Wightman and A. Hudson. Dated February 27th.

4,371. "Improvements in the construction of standards of electrical resistance." A. D. Hughson. Dated February 27th.

4,393. "Improvements in filaments for electric incandescent lamps." Godfrey-Bamberg. Dated February 27th.

4,404. "Improvements in electric switches." B. M. Drake and J. M. Gorham. Dated February 27th.

4,406. "Improvements in and connected with electrical storage batteries." E. A. McLachlan. Dated February 27th.

4,427. "Improvements in the construction of armatures for alternators and such like machines." H. F. Parshall and The British Thomson-Houston, Ltd. Dated February 27th.

4,432. "Improvements in electrical resistances." W. J. Davy. Dated February 27th.

4,434. "Improvements in or connected with moulds for use in the manufacture of secondary battery plates or supports." F. King. Dated February 27th.

4,4.0. "A compensated hotstrip ammeter for the measurement of electric current." H. B. White. Dated February 28th.

4,617. "Improvements relating to electric railways." C. Coerper. Dated February 29th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1895.

1,536. "Improvements in or in connection with alternating current electric motors." C. E. L. Brown, W. Boveri, and F. Funk. Dated January 22nd, 1895. (Date claimed under Section 103 of Act, July 3rd, 1894). Relates to the use for the purpose of starting an alternating current motor with great power, but with slight reaction upon the network of conductors connected therewith, of electrolytic or storage cells arranged so as to be capable of being included in a part of the inducing and induced windings, or in the induced winding alone, of a single phase motor, or in the induced winding of a polyphase motor. 2 claims.

2,804. "Metallic mixtures and alloys for effecting electro-chemica decomposition." O. Imray. (L. Diehl.) Dated February 8th, 1895. Describes a metallic mixture for the decomposition of water and precipitation of gold and silver from cyanide solutions, consisting of a metal such as aluminium or magnesium, having an earthy oxide or several such metals compounded with one or more of the metals, lead, tin, zinc, or analogous metals, the resulting compounds being such as to disengage hydrogen from water. 2 claims.

2,999. "Improvements in and means to be employed for the obtainment of zinc from its ores, and the electro-deposition of zinc upon iron or other metals or alloys." The Cowper Coles Galvanising Syndicate, Limited, and Sherard Osborn Cowper Coles. Dated February 11th, 1895. In obtaining zinc from its ores or in depositing zinc upon iron or other metals, an electrolyte is employed, consisting of or containing zinc sulphate and iron sulphate converted to the ferric condition and also containing zinc dust. Means are also described for passing the electrolyte into a separate vessel, and thence back to the electrolytic cell and revivifying the solution by means of zinc dust with or without the addition of zinc sulphate. 4 claims.

4,466. "An improved arrangement of lenses for search light proprietors." E. J. Paterson and C. W. Hill. Dated March 2nd, 1895. Supplementary prismatic lenses are mounted on pivots in front of or behind the main lenses. The main lenses are arranged to deliver a bifurcated beam of light which is unaffected when the supplementary lenses are turned edgewise to the main lenses. When the supplementary lenses are turned on their pivots, so as to be parallel to the main lenses, the bifurcated beam is converted into a single beam. 2 claims.

5,003. "Improvements in electric condensers." S. Z. de Ferranti. Dated March 9th, 1895. Hitherto tin foil or some such substance has been used in electric condensers as the conductor on the surface between the di-electric plates. In this invention the di-electric is coated by means of a chemical deposition process. According to one method a sheet of ebonite is taken and given a silver coating, as in making looking glasses. This coating then acts as an electrical conductor, and is then thickened by electro-deposition. A number of these prepared plates are then placed close to each other and the space filled up with oil, wax, &c., and then connected by fine wires which act as fuses to cut out any defective plates. Another method is described. 10 claims.

5,086. "Improved means for connecting the branch wires of an electric lamp to the main conductors, or for other similar purposes." H. C. Cowx. Dated March 11th, 1895. Relates to a rose, or fitting, provided with a suitable cover and a division wall or partition, and so formed that the main conductors can pass through it, and, whilst insulated as perfectly as possible from each other, can be set in the rose itself in electrical connection with the respective terminals of the branch conductors of the lamp. 1 claim.

5,956. "Improvements in thermometric circuit closers or alarms." R. Pearson. Dated March 21st, 1895. Instead of sealing one of the contact wires into the glass, so that it is always in contact with the mercury, both wires are sealed in at the same place out of contact with the mercury at normal temperatures, and when the mercury rises in the tube it reaches both wires at once. To prevent the contacts from being acted upon by mercury vapour a column of fluid of an insulating nature is provided above the mercury column. 3 claims.

22,985. "A contact device for the transmission of electric current." C. Bremer. Dated November 30th, 1895. Consists of a bulb, or pear-shaped piece, adapted to fit an ordinary lamp socket or holder. The bulb is provided with flexible leads joined to terminals at the top of the bulb, which terminals make connection with the socket terminals in the lampholder. 2 claims.

1896.

130. "Improvements in and relating to electric accumulators." R. J. Gulcher. Dated January 2nd, 1896. Relates to fabric for supporting the active material, which fabric is formed by interweaving lead wires as the warp and glass threads as the weft. A suitably sized piece of this fabric is surrounded by a cast lead frame and the active material pasted on in the usual way. The plates in the cells are separated by being wrapped in glass wool. 2 claims.

265. "An improved reflector for electric glow lamps." H. N. Bickerton. Dated January 4th, 1896. The reflector has the form of a disc with a central hole of approximately the same diameter as the upper part of a glow lamp, the disc is held in place upon such upper portion by projections or a rim formed round the edge of the hole. 1 claim.

452. "Improvements in apparatus for controlling electric motors." H. H. Lake. (B. A. Fiske, U.S.A.) Dated January 7th, 1896. The motor is operated by current from a separately excited dynamo driven by a prime mover. The motor is also separately excited and a switch is provided which, by means of one handle, controls both the current in the field magnet circuit of the dynamo and also the direction of current in the armature of the motor. 2 claims.